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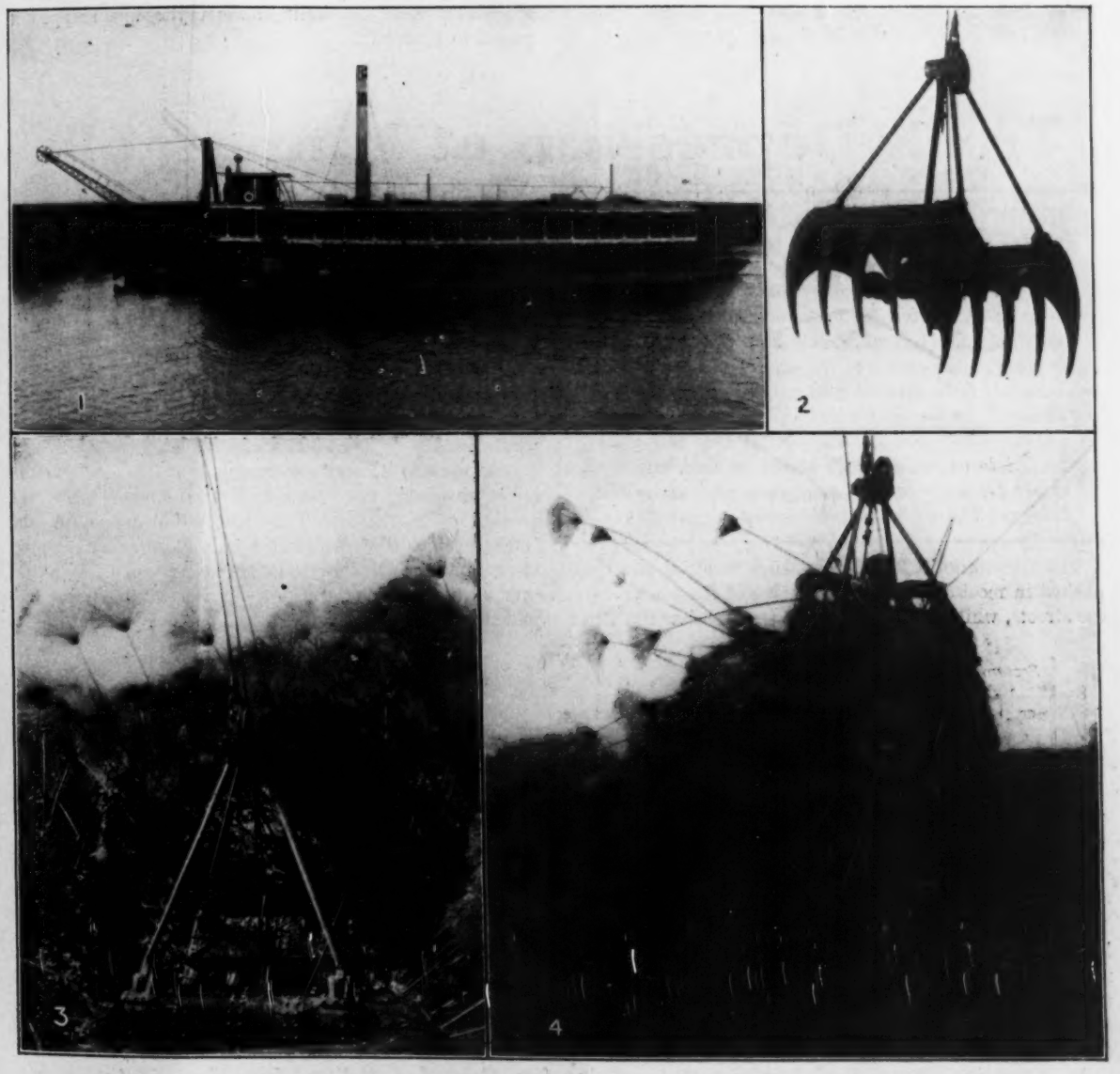
Dredging "Sudd" on the River Nile

An unusual dredging problem is presented by the extraordinary vegetable growths that infest a portion of the Upper White Nile. About 2000 miles from the mouth of the river is a vast swamp region covering perhaps 10,000 square miles through which the river finds its way by various channels. This area is covered by a growth of the papyrus reed, known locally as "sudd," which sometimes encroaches on the river channels to such an extent as to close them entirely. The papyrus has a smooth tapering stem from 12 to 18 ft. high surmounted by a plume, and is very picturesque. The stem, of triangular section with rounded corners, is very tough and elastic. The root mass is semi-floating and becomes very dense and tough. Masses become detached and float downstream like islands, forming a jam that is immovable.



VIEWS OF DREDGE WORKING IN THE REEDS OF THE UPPER NILE

Fig. 1. General view of dredge. Fig. 2. Near view of tongs. Fig. 3. Tongs buried in reeds. Fig. 4. Tongs with load of reeds.

When navigation became obstructed in this way it was formerly the custom to send natives into it with tools to cut the roots by hand and endeavor to pull out the mass bit by bit with wire ropes, a slow and sometimes impossible operation. In order not only to keep navigation open but also to conserve the river and reduce loss by wastage into the swamp area and by evaporation, the Egyptian Government has been doing some experimental dredging on a large scale, and for this purpose has had built the specially designed dredge shown in the accompanying views.

This dredge is built on the lines of a light-draft river steamer of the stern-wheel type, having a steel boom 60 ft. long at the forward end for working a grab bucket of about 8 cu.yd. capacity. The grab is specially designed with long tapering steel tines to penetrate and close upon the roots, and sufficient power is applied to pull out the mass bodily. The illustration Fig. 3 shows the grab embedded in the swamp, and Fig. 4 shows a mass of vegetation being lifted out, the pictures being taken from the bow of the dredge.

The hull of the dredge is of steel, 160 ft. long by 32 ft. beam and with 3 ft. draft of water. Two steel spuds are fitted with special feet of large area to bear upon the soft bottom. The spuds are so designed that they can be lifted clear of everything and present no obstruction to navigating the vessel. This dredge is fitted with large fuel storage and also moderate accommodation for passengers and freight, so that she can navigate long stretches of the river, and can also be used as a tow-boat. The distance from the base of supplies at Khartoum to the swamp district is about 800 miles. Since this vessel has been placed in commission the stoppage of navigation in the sudd region has become a thing of the past, and being fitted also with other buckets for mud and clay, she has been employed more or less in other work.

This vessel was built in 1909 from designs by A. W. Robinson of Montreal, Consulting Engineer to the Egyptian Government for this work. The dredging machinery was by Stothert and Pitt of Bath, Eng., the propelling machinery by a Clyde firm, and the hull and general machinery were also built in the Clyde, and shipped in pieces to Khartoum.

Track Depression at Minneapolis

SYNOPSIS—To eliminate street crossings a stretch of track nearly three miles long has been depressed, and is crossed by nearly 40 street bridges. A special problem was the maintenance of spur connections to numerous industries along the line. At several streets also the grade line is close to the crown of the sewer, and the sewers have had to be covered with concrete saddles. An unusual feature in the bridges is a curved shelf on the outer face of the girder, this being intended to act as a smoke shield by diverting the smoke from the parapet as engines pass under the bridge. The work is being done by company force.

The elimination of grade crossings in cities is accomplished in most cases by the elevation of the tracks above the streets, while the depression of tracks below the street level is of much less frequent occurrence. The latter method usually involves special difficulties due to intersection of or interference with sewers, water and gas mains, etc., and the work is usually attended with greater difficulty than track elevation.

An interesting piece of track-depression work now in progress is that on the Hastings & Dakota Division of the Chicago, Milwaukee & St. Paul Ry., at Minneapolis, Minn. This division commences by junction curves from the main line at the South Minneapolis shops and extends westward in a straight line just north of and parallel with 29th St., from Cedar Ave. nearly to the city limits. It was built originally at the street level, and passes largely through a residence district, although for a considerable part of its length it is bordered by elevators, coal yards, lumber yards and other industries.

In 1910 the city passed an ordinance requiring the railway company to lower its main tracks, and (with only one exception) to separate the grades at every existing street crossing from Cedar Ave. to Hennepin Ave. On account of the favorable conditions for depressing the tracks between these points, the railway company accepted the ordinance. But as there was no provision for taking care of the industry tracks a number of the industries joined forces and by legal proceedings delayed the beginning of the work until late in 1912. This controversy is noted below. The cost of lowering the main tracks was estimated at $1,000,000, but the compromise increased the estimate to something over $1,500,000.

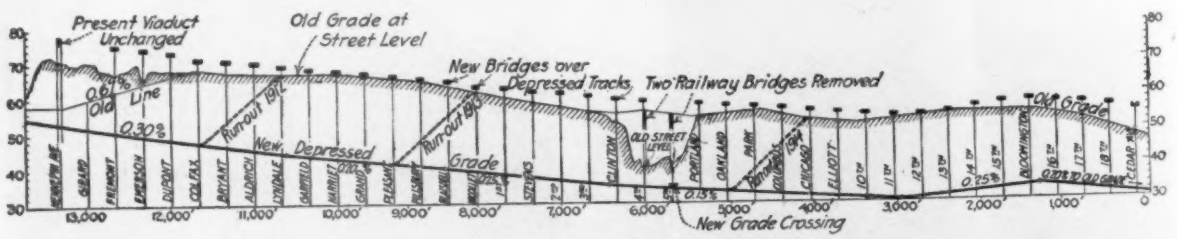


FIG. 1. PROFILE OF TRACK DEPRESSION OF THE CHICAGO, MILWAUKEE & ST. PAUL RY. AT MINNEAPOLIS, MINN.

As the ground falls away from the general level east from Cedar Ave., and west from Hennepin Ave., it was decided to lower the line between these points, a distance

of 3 mi., involving nearly 40 street crossings. This improves the grades of the connections at either end. The depression is about 20 ft., and the streets are raised about 3 ft. over the cut by inclined approaches of 3% grade, so that all street bridges have a minimum clearance of 18½ ft. The grade of the revised line is flat, ranging from 0.15 to 0.3%. The old and new profiles, with the position of the various bridges, etc., are shown in Fig. 1.

The work was commenced in 1912 at Hennepin Ave., which street has for several years been carried over the tracks by a viaduct. At this point the old line ascended to the ground level (and street level) by a grade of 0.67%, shown in Fig. 2. The pipes are inclosed in frost-proof boxing and are laid upon these slabs. Electric and telephone conduits are carried in the same way, while the gas mains are carried under the bridge abutments and beneath the tracks.

The sewers are mainly below the grade line, but in many cases with only a few inches of cover. These sewers are protected by reinforced-concrete saddles as shown, new manholes being provided outside of the right-of-way. Several of these old sewers while uncovered gave trouble by bursting during heavy rains (when they flowed to full capacity), thus discharging water into the cut. Where the sewers were not deep enough to permit the track de-

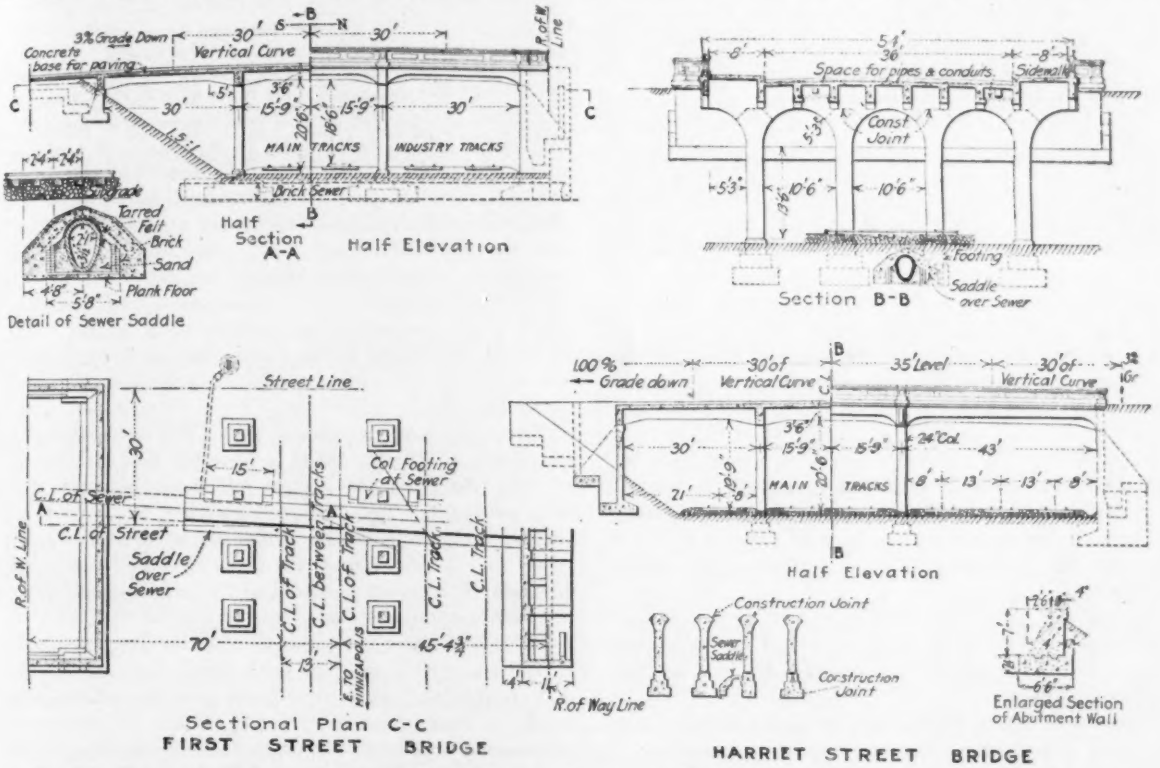


FIG. 2. REINFORCED-CONCRETE BRIDGES OVER THE DEPRESSED TRACKS AT MINNEAPOLIS, MINN.; CHICAGO, MILWAUKEE & ST. PAUL RY.

(The tracks under the side spans are for industry connections)

while the new line has a descending grade of 0.3%. At the end of that season a run-off or incline of 2% grade was built, running out on the old level at Lyndale Ave.; in 1913, the run-off was at Nicollet Ave., and that for 1914 will be at Chicago Ave., while it is expected to complete the work to Cedar Ave. in 1916.

Although the ground is practically level, there is a ravine between Portland and Clinton Aves., where 4th and 5th Aves. were formerly crossed by railway bridges. A grade crossing will be maintained at 5th Ave., but at 4th Ave. the old subway will be replaced by a viaduct with long approaches, as this street is an important thoroughfare with a double-track car line.

Water mains, gas mains and sewers are encountered at most of the cross streets. The water mains were cut temporarily and are being relaid permanently between a pair of the girders of the concrete bridges. For this purpose each of these girders has a ledge on the bottom of the inner side, forming shelves to support concrete slabs, as pression, they were diverted to the nearest sewer of adquate capacity.

For a part of the distance, 29th St. is parallel with the railway, and its north line coincides with the south right-of-way line, so that in some instances a retaining wall was required to support the street. This is surmounted by an iron railing instead of a parapet wall.

The roadbed is of ample width for drainage, and at intervals of about 300 ft. there are special catchbasins with connections to the sewers. These are of concrete, 2½x5 ft., with an iron grating on top to retain large pebbles, etc. At the side of the catchbasin is a low toe wall to prevent material from the slope of the cut being washed down upon the grating.

INDUSTRY TRACKS AND FACILITIES

The industries noted above introduced special problems in regard to their track connections, and these were a source of controversy. The right-of-way was generally

100 ft. wide, with one main track and from one to five additional tracks to provide service to industries on either side. The width was sufficient generally for two main tracks and the slopes of the new depression.

The question raised by the industries was as to the railway company's liability for the changes necessary to be made in industry tracks, since the lowering of these tracks and adjusting the industries to be served from the lowered tracks represented a very considerable expense. The industries claimed that the railway company should bear this expense. The company contended that the tracks were to be lowered, not of its initiative and for its benefit, but by order of the city authorities and as a measure of public safety; and therefore the industries should make the necessary adjustments themselves and entirely at their own expense, including the cost of the changes in the tracks serving them.

The litigation was compromised by the railway company agreeing to put in one track (to be called a service track) in addition to the two main tracks, leaving the industries to stand the cost of providing the additional trackage necessary to serve them, these latter tracks to be laid next to the right-of-way lines, and the industries at their own expense to adjust themselves to these tracks. All such tracks were laid at the grade of the main tracks (instead of rising on an incline to the old elevation) and this required a considerable depression of the industries.

Where the right-of-way was not wide enough for the two main tracks and one service track, the railway company contributed to the cost of the industry track an amount which was approximately what would have been required if a retaining wall had been built to hold the slopes for the three tracks within the right-of-way limits. The result has been a great burden of expense to the industries, and a large additional burden on the railway company.

It has been pointed out in this connection that in many cases the elimination of grade crossings by track elevation or depression cannot be brought about without hardship to the abutting interests, especially where these are industries in which the railway is giving service. Further, the railways are not under obligation to assume the expense of restoring these facilities, and much less to assume the cost of adjustments necessary to be made in the industries to permit of the continuation of track service from the railway.

The industries required special treatment to suit the conditions and requirements of each case. In some cases a retaining wall had to be built at the right-of-way line, surmounted by a reinforced-concrete fence. In other cases, the owners permitted the slope of the cut to extend over their property, a toe wall being built at the right-of-way line. This occurred usually where a trestle or other structure at the upper level could be built over the slope. In one case, where 29th St. is parallel with and adjacent to the top of the retaining wall of the cut, an industry had a warehouse on the opposite side of this street. Here a track and team driveway have been provided on the railway side, and a lateral subway built under 29th St. to enable the industry's wagons to drive down a private road from 30th St. and pass under 29th St. to the team driveway.

It is interesting to note the different methods adopted for handling coal in three of the coal yards on this line. In one case, the coal yard is at the track level, with an inclined driveway to the street; coal is delivered from cars into a track hopper and carried by an elevating conveyor to large elevated storage bins of timber construction, beneath which the carts drive to take their supply from various chutes. In another case, the yard is at the street level with a steel storage bin built close to the edge of the cut, and provided with a traveling hoist upon the roof with a horizontal carrier to distribute the coal to the various bins. In the third case, the yard is at the street level, but the concrete elevated dock is set back from the tracks. Here the cars deliver coal to a track hopper beside an elevator tower, from which an inclined conveyor bridge extends over intervening tracks to the bins.

Street Bridges

There will be 37 bridges. These are of reinforced concrete of the slab-and-girder type, with three spans, the girders and slabs forming a continuous structure from end to end. The center span, 31 ft. 6 in. c. to c. of columns, covers the double-track main line. The side spans are usually 29 ft. in the clear (sometimes 42 ft. where three tracks are spanned) and cover a bank slope, team driveway, industry tracks, etc., according to the local conditions. Two typical designs are shown in Fig. 2. The bridges are about 350 ft. apart, and a view along the track gives the general appearance of a tunnel. The width of the bridges varies, and is such as to conform to the width of the roadway with an 8-ft. sidewalk upon each side.

The soil is sand and gravel; with a few clay seams, and no piling is required, but it is provided that the bearing of foundations on the natural soil shall not exceed 2½ tons per sq.ft. The pier footings have to be modified in shape in some cases, where they are adjacent to a sewer (Fig. 2). These footings are made long and narrow (at the side of the sewer) instead of the usual square shape. The street-approach grades are in general 3%, with 60 ft. of vertical curve at the middle of the bridge.

The concrete is of stone with proportions as follows: 1:3:6 for footings of the bents and for all concrete work of gravity section; 1:2½:5 for all reinforced abutments, and 1:2:4 for the columns, girders, floors and handrails. The aggregate consists of torpedo sand and granite screenings of ½- to ¼-in. size. The reinforcement is of deformed bars, which are cut and bent at a neighboring yard and assembled on the work. Some of the stirrups have the upper ends of the legs bent over, horizontally so as to hook upon the sides of the form. This eliminates the use of blocks to keep the stirrups above the bottom of the form.

In construction, the footings are built first, and then the columns, the latter being finished with enlarged heads, as shown, to carry the cross-girder built later. The beams and deck slab are then poured at one time. The falsework and floor forms are left in place from two to three weeks before removal. The handrail forms have usually been allowed at least 48 hours before removal. Previous to this season, the handrail forms were removed after 24 hours and the face of the concrete was brushed with a stiff wire brush to expose the red granite screenings in the aggregate.

It was decided to discontinue this practice, as a smooth concrete face seems to give a more pleasing effect and to bring out more clearly the angles and planes of the design. As a consequence, the hand rails as they are now

built, show a smooth concrete face. They are rubbed with emery stone just enough to take out surface irregularities or brushed with cement grout to remove surface discolorations.

A rather novel deck construction on the Nicollet Ave. bridge provides for a future widening of the present 50-ft. roadway to 60 ft. The concrete roadway deck is made 60 ft. wide, with 10-ft. sidewalks, but the latter are widened to 15 ft. by hollow tile blocks laid upon the roadway and covered with a thin layer of concrete. Whenever the city desires to widen the roadway, the 5 ft. of tiles can be removed readily, without affecting the structural design of the bridge.

The bridge parapet walls are 3 ft. high, paneled as shown in Fig. 3. In removing the forms from these, the cleats *A* are removed and the lagging loosened. Then the cleats *B* and bolts *C* are removed (the latter having been greased before placing). Next, the 2x6-in. studding is

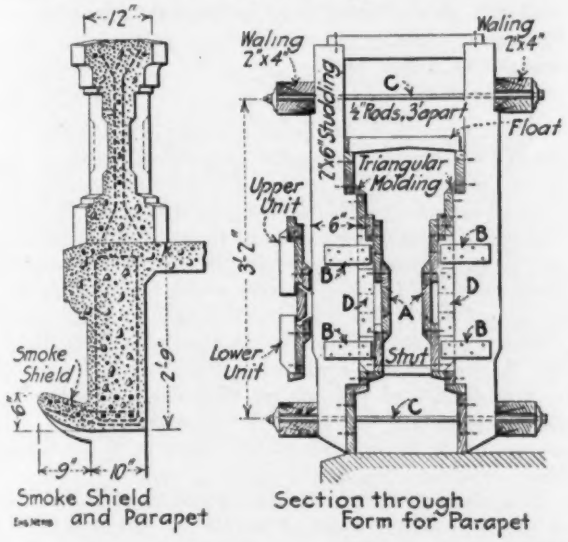


FIG. 3. SMOKE SHIELD, PARAPET AND PARAPET FORMS FOR BRIDGES OVER DEPRESSED TRACKS AT MINNEAPOLIS, MINN.; C., M. & ST. P. RY.

removed, with the lagging attached. Finally the strips *D* are removed and the remaining lagging is taken off by dropping the upper unit and raising the lower one, as shown. An unusual feature of the bridges is a smoke shield, intended to throw the smoke away from the parapet wall. This is a ledge 9 in. wide formed along the bottom of each fascia girder, as shown in Fig. 3.

Temporary bridges with framed timber bents and joists are constructed wherever it seems necessary and street-car traffic is carried on a temporary bridge at one side of the bridge site. At one street, where a regular temporary bridge was not required, but where school children crossed the work, a narrow timber footbridge was built. This had high close-boarded sides, sloping outward at the top, to prevent the inquisitive children from hanging over the edge.

Behind the abutments and retaining walls are 4-in. tile drains which lead either to a catchbasin or to weep holes through the walls.

CONSTRUCTION METHODS

The excavation is done by steam shovels, the gravel soil standing well. The material is removed by standard-gage equipment and used largely as filling for enlarging the site of a freight yard. It was found possible in many instances to make the excavation for bridge abutments just previous to steam-shovel cuts, the excavated material being thrown out in front of the abutment site and loaded by the steam shovel on its next cut. When it was impossible to do this it was necessary to load the excavated material on cars by hand.

There are 16 to 20 trains daily over the line, besides a heavy switching service to accommodate the numerous industries. On part of the work, a temporary running track was laid on the surface, outside of the line of the cut and being partly on private land and partly in 29th St. At some points this was used until the completion of the depressed work, but at others it was abandoned as soon as one track could be laid through the cut, and the traffic was operated on this latter track. The grades of the run-outs at the end of the depressed section are about 2.8%, but trains have been operated temporarily over grades of 5%, using a pusher engine for the assistance of passenger trains.

The portable concreting plant travels on the construction track at the lower level, and has a ½-yd. mixer of the drum type mounted at the rear of a flat-car. Behind this is a pile-driver car, converted into a concrete elevator, using the leads as guides for a ½-yd. dump bucket having the discharge door at the bottom of the forward side. The empty bucket drops into a pit beneath the ties, and a short hinged chute is swung out to receive the concrete dumped from the mixer and deliver it to the bucket. The chute is then raised and the bucket hoisted. At the top, an attendant trips the side door, which falls outward to form an apron connecting with the chute through which the concrete flows to the forms. This bucket was designed by the engineering department, and it is planned to make the side door operate automatically.

On the first part of the work, stationary stiff-leg derricks at the ground level were used to handle the forms and concrete buckets, but the present arrangement for concreting is more convenient. The stiff-leg derricks were used this season at places where they were already set up, but at other bridges A-frame derricks fitted with hand crabs or hoists were used to erect the falsework for the bents and the bent forms. The falsework timbers and floor forms were erected from the street level, the timbers being run out on dollies and the floor forms assembled and carried to place. Although the bridges vary in dimensions, it has been found possible to use sectional floor forms by making slight changes. These have been used as many as three times, while handrail forms have been used on five bridges before being discarded. The forms for the bent columns have also been made sectional.

ENGINEERS

The work is being done by the railway company's engineering department, most of the construction work on this road being built by company force. From 200 to 300 men are employed. W. R. Powrie is District Engineer, and F. M. Sloane is foreman in charge (for the Engineering Department). The design and execution of all the work are under the general direction of C. F. Loweth, Chief Engineer of the Chicago, Milwaukee & St. Paul Ry.

Tie-Rods for Floor Arches; A Criticism of Current Practice

By Frank N. Kneas*

The frequent practice of putting ¾-in. tie-rods on 5-ft. to 7-ft. spacing for terra cotta floor arches spanning between steel beams, without due study of the span and depth of the arches and of the weight of the floor loads, appears to be open to criticism from the standpoint of engineering thoroughness.

End Panels, and Relation of Thrusts

At first sight it may seem that in a series of arches the thrusts of adjacent arches counteract one another and that therefore there is no necessity for tie-rods excepting in end panels or in panels at the sides of stair-wells or other openings. The view that tie-rods in such end panels will take care of all lateral thrusts is not correct.

In the series of arches shown in Fig. 1, assuming all of the loads equally distributed, the arch thrusts *a*, *b*, *c*, *d*

FIG. 1

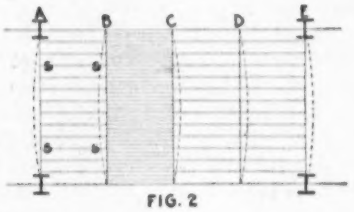


FIG. 2

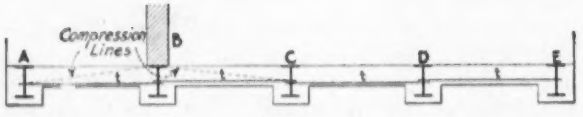


FIG. 3

and *c* will all be equal. Therefore at beam *B* the arch thrust *b* on the one side will exactly balance the arch thrust *b* on the other side. But the thrust *a* on the outside beam *A* exerts by the tension *t* in the tie-rod an unbalanced pull on beam *B*. There is an unbalanced pull on beam *D* in the opposite direction, also equal to *t*. To preserve equilibrium tie-rods must be supplied between *B* and *D*. Thus, even assuming all the arches of equal span, equal depth, and equal loading, tie-rods must be used in interior as well as end bays.

If any dependence is placed on the thrusts of adjacent arches balancing one another, then unequal loading of one arch immediately exerts unbalanced thrusts on all adjacent arches.

Shear between Blocks

Let us take still another view of the question. The sketch Fig. 2 has been prepared as a typical plan of a series of arches with load on bay *BC*, shown shaded. The load causes arch thrusts on the beams *B* and *C* which, if not *fully* restrained by tie-rods, tend to make the beams bend laterally as shown by the dotted lines. Consider the arch between *A* and *B* as a horizontal beam, the thrusts cause shear stresses along such lines as *SS*. The cotta arches are usually laid in a manner that does not provide much bond between the sides of the different series of blocks, and it is easily conceivable that the sliding stresses might cause cracks along the joints between the series of arch blocks just referred to, besides overstressing the steel beams due to lateral bending stress.

Bridging Action

There is one more phase to be considered, and to illustrate it Fig. 3 is given. Assume beam *B* to be overloaded from any cause, say by a heavy partition, while the adjacent beams are lightly loaded. If beams *A* and *C* are connected to *B* by sufficient tie-rods to resist the horizontal components of thrusts along the dotted lines, the terra cotta arches (if of sufficient depth) will act in a manner similar to bridging between wooden floor joists and will give to beam *B* an additional factor-of-safety against overloading by transferring part of the loads from *B* to *A* and to *C*.

Double Rods

From a practical standpoint it might be noted that the figured thrusts for the regular arch action sometimes require the tie-rods to be spaced close together, or else that they be larger than the usual ¾-in. diameter. As most beamwork is framed with ¾-in. rivets, it is desirable to use ¾-in. tie-rods, because larger rods would require the punching of two sizes of holes, which is expensive. An expedient which has been found useful to avoid much cutting of the terra cotta is to place the rods about double the figured distance apart when the theoretical spacing is very close, and put one set of tie-rods directly over the other, keeping the centers of the pairs of rods as close as possible to the bottoms of the beams or to the thrust lines.

It is also well to have the rods spaced apart in the clear in multiples of the width of the tile, as this helps to reduce the splitting of the tile to the minimum.

Rise of Arch

Most structural handbooks give the necessary formulas for figuring the required tie-rods, both to resist the arch thrust and to keep the stresses in the steel beams within the proper limits, but even here caution must be observed in applying the formulas, especially as to the effective rise of the arch.

For instance, take a 12-in. flat terra cotta arch spanning between 12-in. beams 6 ft. on centers, where a *flat ceiling* is desired in the terra cotta construction. The usual practice is to have the bottom of the arch 2 in. below the bottom of the beams to allow for fireproofing the steel, so that we only have at the most 10 in. above the bottom of the beam to the top of the arch; and due to the irregularity of the arch blocks we may have less. The center of the compressive stresses must be at least an inch or more below the top of the arch. The tie-rods are usually 3 in. above the bottom of the beams. So the distance from the center of the compressive forces to the center of the tie-rods, for such conditions, cannot be more than 6 in. For a total load of 150 lb. per sq.ft. on the arch the thrust causing tension in the tie-rods will then be:

$$\frac{150 \times 6 \times 6 \times 12}{8 \times 6} = 1350 \text{ lb. per lin.ft.}$$

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which would call for ¾-in. tie-rods not over 4 ft. on centers (or say 4 ft. 1 in. on centers to avoid cutting blocks to fit between the rods).

This allows a stress of 18,000 lb. per sq.in. in the tie-rods. This spacing is closer than examples given in most handbooks, and the subjects of arch stresses and tie-rod spacing seem to be worthy of more attention than is usually given to them, especially for heavy floor-loads.

In the example given above, the horizontal thrust to be taken up by the tie-rods is 1350 lb. per lin.ft., while the vertical load is only 900 lb. per lin.ft. The horizontal thrust on the bottom flange of the beam (spanning between tie-rods) will be $\frac{6}{8\frac{1}{2}} \times 1350 = 953$ *lb. per lin.ft.* which force would act as in Fig. 2 to bend the bottom flange, and is active especially in the end bays.

Conclusions

The correct method is to design each arch for its own condition of span, depth, and loading, and to supply the necessary tie-rods to all of the arches without relying in any way on adjacent arch thrusts. This also allows at any time during the construction of the building, or at any time later, alterations to be made, even though they require the removal of an arch (as to provide for a new well opening or any other kind of an opening), without disturbing the equilibrium of adjacent arches.

On several recent buildings, the beams were spaced approximately 7 ft. on centers, the terra cotta blocks were 15 in. deep, the top of the terra cotta was 13 in. above the bottom of the beams, with cinder concrete fill above. The total floor loads varied from 170 lb. per sq.ft. to 320 lb. per sq.ft. The tie-rods (not upset, to avoid having two sizes of punching in the beams) were called for as follows:

For 170 lb. total load, ¾-in. rods, 4 ft. 7 in. on centers.
For 225 lb. total load, ¾-in. rods, 3 ft. 5 in. on centers.
For 320 lb. total load, ¾-in. rods, 2 ft. 6 in. on centers.

Doubling of the rods was allowed for the closer spacings to avoid the extreme amount of cutting for the terra cotta. Even at this spacing, which is closer than ordinarily used, the stresses in the rods ran rather high, though of course in all cases some distributing action can probably be relied on due to the cinder concrete fill, and to the flooring.

The Little River Drainage District

A vast amount of work is being done in the Southwest in reclaiming swamp and overflowed lands. This work is done mainly by drainage districts organized under state laws. The Little River drainage district, a map of which is shown in Fig. 1, is in the southeastern section of Missouri and directly adjacent to the St. Johns drainage district described in our issue of Sept. 17, 1914. The district is managed by a board of supervisors, of which John H. Himmelberger is President. The Chief Engineer is William A. O'Brien, of Cape Girardeau, Mo., and Isham Randolph, of Chicago, is Consulting Engineer.

The district covers an area approximately 10x90 miles, containing 488,000 acres. It is subject to overflow at times of high water in the Little and Castor rivers (flowing from the Ozark foothills), and as the slope to the south is less than that of the territory at its northern end, the water does not flow off as rapidly as it is received.

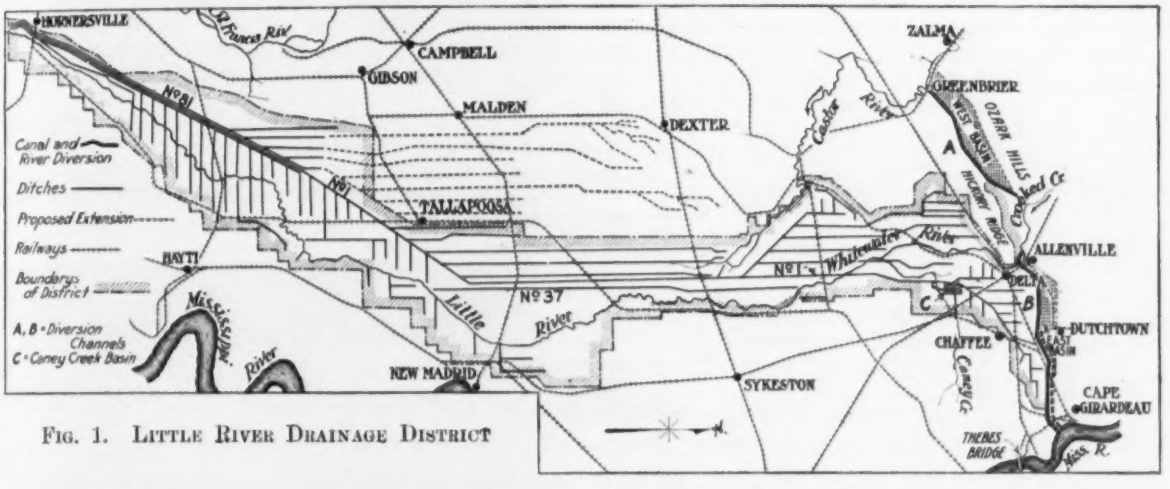


Fig. 1. Little River Drainage District

The plan adopted for drainage is to divert these streams into the Mississippi River at the north end of the district, and to build a system of about 625 miles of drainage ditches and 40 miles of levees to provide for local drainage after the headwaters have been disposed of by the diversion. An additional area of about 56,000 acres (outside the present limits) will be benefited by these works and will be added to the district later.

The assessed valuation of lands within the district is $7.50 per acre (or $3,664,440), which is about 20% of the actual value as indicated by sales. The total benefit assessed against the lands is $13,202,285. A bond issue of $5,000,000 at 5½% will provide funds for carrying out the work and these bonds have been sold. Contracts have been let for most of the ditch and levee work, aggregating $3,965,950. These cover 15,223 acres of clearing and 42,829,690 cu.yd. of excavation, the contract prices for the latter ranging from 5½ to 14c. per yd.

The total drainage area whose run-off will have to be taken care of is about 1136 sq. miles. The natural drainage channels and their tributaries form a net work of minor valleys, and water falling on the hills travels not more than ¼ mile to reach a channel. The soil is a yellow clay underlaid with hardpan and absorbing water very slowly. About 25% of the area is under cultivation.

The greatest 24-hr. rainfall upon record in this territory is 6.45 in., at Jackson, Mo., in July, 1905. The run-off for this has been estimated at 50 cu.ft. per sec. per sq.mi., but would be heavier for a storm with the same precipitation coming after a prolonged period of rainfall. For this reason the run-off unit employed in the design of the drainage district was 28 cu.ft. per sec. per sq.mi. for the first day, 80 for the second, 56 for the third and 32 cu.ft. for the fourth and last day. The highest known flood in the Mississippi River was that of 1844, which reached an elevation of 346.23 ft. above the mean level of the Gulf, or 12 ft. over the banks at Cape Girardeau. All designs to handle the headwaters were based upon the above maximum rates of run-off for the entire area, occurring simultaneously with a flood height equal to that of 1844.

Storage of Flood Water

Floods from the headwaters of rivers which enter the district are to be diverted eastward into the Mississippi River. The flood waters are to be stored in three basins, from which channels and floodways extend to the Mississippi. These basins (West, Middle and East) have a combined area of 23 sq.mi. The East basin also gives the necessary head for outlet into the Mississippi River when that river is at flood stage. The cost of this part of the work is estimated at $1,145,000.

A diversion channel will extend from the Castor River near Greenbrier, eastward to Crooked Creek, about 14½ mi. This is shown at (A) in Fig. 1. A levee on the south side 10 to 22 ft. high, in conjunction with the foothills on the north, will form the West Basin (for the Castor River floodwaters), of such capacity as to require 48 hr. for the maximum run-off to fill it.

In continuation of this channel, Crooked Creek and Whitewater River, will be enlarged and improved for about two miles to a point near Allenville. From this point, a second diversion channel will extend 15 mi. east to the Mississippi River outlet, 2½ mi. below Cape Girardeau, as shown at (B), Fig. 1. A levee 15 to 24 ft. high will extend the full length of this channel along its south side, while on its north side a levee will extend from Dutchtown to the Mississippi. These levees form the south and east sides of the East Basin. To facilitate flow in the basin, a floodway 1000 ft. wide will be cleared on the north side of the channel. From the East Basin, the channel will have a bottom width of 74 ft. and average depth of 14 ft., with a clear floodway width of 900 ft. with a mean depth of flow of 14 ft.

The floodways are strips of land cleared of all timber and débris, with levees on each side and with a channel on the south side of the floodway to care for low-water flow and freshets. On the outer or north side of the north levee is an intercepting drainage ditch. Sections of the diversion channels are shown in Fig. 2.

The railways will have to raise their grades to the level of the new levees, and build viaducts across the floodways. Permission to cut through the Mississippi River levee at the outlet has been granted.

Drainage of the District

With the floodwaters excluded by the diversion channels and levees above described, the interior drainage of the district is to be taken care of by a system of ditches. The mean annual rainfall for the territory is 42.96 in., with an average recorded maximum for the entire area of 10.82 in. in three days. The system is designed to provide for a 3-in. rainfall in 24 hours. The complete reclamation of the valley involves about 625 mi. of open ditches. In general these will be parallel and about a mile apart, running north and south. The bottom width is from 4 to 123 ft., and the depth 8 to 11 ft., with side slopes of 1 : 1 and a minimum width of 10 ft.

The fall is about 1 ft. per mi. The ditches of the existing smaller districts within the territory are tapped by the main ditches. As the system expands, the size of the ditches increases, and at ditch No. 81, about 60 mi. down the valley, it was necessary to construct the main ditch (No. 1) in three parallel units, for economical construction. This is shown in the plan, Fig. 1.

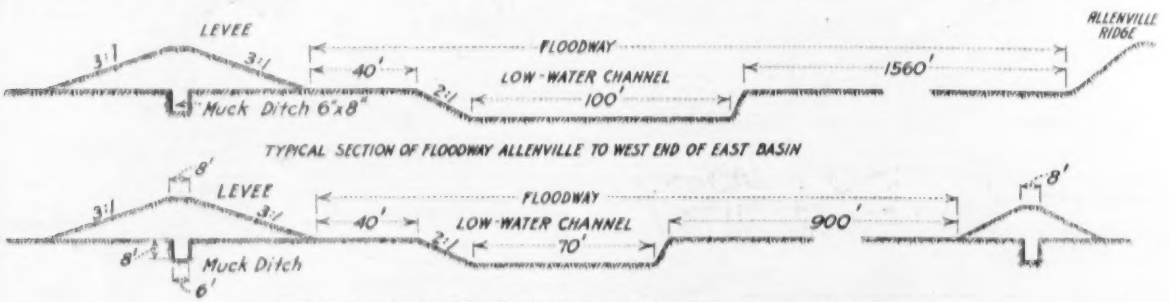


Fig. 2. Sections through Diversion Channels, Little River District

Caney Creek, near the north end of the district, will discharge into a basin of about 400 acres, the flow from which will be through a concrete tunnel leading into ditch No. 1. This is shown at (C), Fig. 1. The purpose of this is to cause the water from this creek to deposit its sediment before entering the main channels. About 58 mi. of ditches have already been completed.

Construction Methods

The excavation of the diversion channels will be done by Dewitt C. Stevens, of Buffalo, N. Y., and it is intended to use electrically operated dragline excavators, supplied with current from a central station at Cape Girardeau.

For the main drainage ditches, dipper dredges will be employed. One of the principal contractors is Otto Kochtitzky, of Cape Girardeau, Mo., who states that his main ditch will be 11 ft. deep, 123 ft. wide on the bottom, 145 ft. at top, with a 15-ft. berm on each side. For this he will use a dipper dredge with hull 42½x120 ft., 90-ft. boom, 4½-yd. dipper, with bank spuds built to set up in 15 ft. of water or on a bank 5 ft. above the water line.

A log-skidding machine, of the type shown in En-

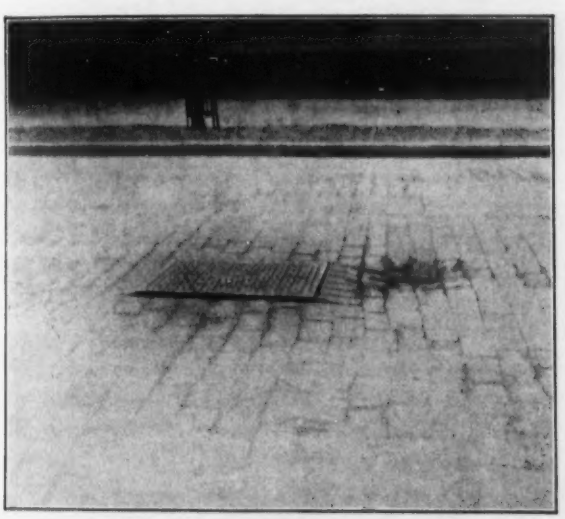
GINEERING NEWS, Sept. 24, is used for clearing on some of the contract sections, where the width to be cleared is about 1400 ft. This is a 30-hp. machine with two cable drums, one for pulling stumps and spotting the machine and one for dragging the timber into piles for burning. At first an older type of machine was used, in which the out-haul of the stump-pulling cable was handled by men or teams. This was not found economical, and was replaced by the machine noted above, in which the out-haul is done by power. The machine has advantage over teams for clearing on boggy land or in timber-grown bayous, and where the width to be cleared is over 100 ft.

New York City Experience with Asphalt-Block Pavements*

By Henry Welles Durham†

The Borough of Manhattan, New York City, contains at the present time a very extensive area paved with asphalt block, amounting to about 2,000,000 sq.yd., of which one-half is still maintained under guarantee contracts. Arguments have been presented to show that the present pavements of this type in Manhattan are being maintained at a less average cost per square yard than those of sheet asphalt, with which type it naturally competes.

In interpreting these cost data, however, it must be borne in mind that a large proportion of the asphalt-block pavement is in the northern part of the borough where traffic is comparatively light. The cost data for the asphalt-block pavement are not, therefore, to be compared with the average for sheet-asphalt pavement maintenance throughout the entire borough, but only with the cost in corresponding sections. If this is done it shows no such advantage on a maintenance-cost basis.



Disintegration of Asphalt Blocks under Heavy Motor Bus Traffic; 110th St., New York

The advantages urged for asphalt block are based on (1) the theory that it is slightly less slippery than sheet asphalt, which, however, experience shows is not the case, and on (2) the claim that it can be more easily repaired by the removal of individual units, whereas sheet-asphalt repairs require an expensive plant and expert labor.

Asphalt block has the advantage that it may be laid like any other block pavement with the advantage of that continuity pertaining to all bituminous-composition pavements. It has the disadvantage that the individual blocks are not composed of hard unyielding material, and hence are not rigid or able to maintain their original shape under pressure or change of temperature; in consequence asphalt-block pavement has not the repair advantages of the other types of block pavement. It has the additional disadvantage that it can not be repaired by the method used for other bituminous pavements, but must have individual blocks substituted by others which being new do not conform to the altered shapes of the old ones.

On many asphalt-block streets, instances can be pointed out where the blocks have traveled, in some instances many feet, in the same way that sheet asphalt flows in hot weather; but unlike sheet asphalt the defects cannot be remedied by cutting out and replacing.

Where asphalt block has been laid under heavy traffic conditions in the Borough of Manhattan, it has failed to give satisfactory service. Notable instances of this can be seen on many streets and particularly on upper Broadway.‡ The asphalt-block pavement on Broadway north of Manhattan St., which was among the worst in the city, has already been replaced with granite block on the hill and with sheet asphalt on the level portion.

Attention is also directed to the asphalt-block sections of the test pavements on Second Ave., which are among those which have required the maximum amount of resurfacing during the past two years. At one place, between 15th and 17th St., the surface traveled in the direction of traffic to such an extent as to expose the foundation, the movement amounting to over 8 ft.

The fact that there are large areas of light-traffic streets where the maintenance cost for the asphalt-block type of pavement has been very small proves nothing. The same streets could probably have been paved satisfactorily with macadam, either water-bound or bituminous, as is done very extensively abroad in residence streets. No instance can be shown where asphalt block has continued to have a satisfactory surface under dense traffic similar to that which has been shown for many years by the sheet asphalt on Fifth Ave.

The greatest drawback to asphalt-block pavement has been its repair after several years' service. Its advocates have pointed to the low figures for percentage of repairs in the light-traffic streets as evidence of its economy, but have immediately thereafter urged that its poor showing in Manhattan is due to the insufficient repairs.

The only method advocated for the repair of asphalt-block pavement is that of removing the blocks over large areas where worn, sorting out such of the blocks as can be used again and laying these culls all together in repaired areas, the remainder being surfaced with new blocks. But such a method of repair presupposes large extents of defects, which, in turn, runs counter to the arguments as to the desirability of prompt maintenance down to the smallest defect, and as to the relative low percentage to be resurfaced as compared with other types of pavement. One or the other argument must be abandoned, and the adoption of either alone leaves its advocate with a poor case in view of the facts.

*From a forthcoming Annual Report of the Bureau of Highways of the Borough of Manhattan, New York City.

†Recently Chief Engineer, Bureau of Highways, Borough of Manhattan, New York City.

‡See "Eng. News," July 16, 1914.

Laying a 6-Ft. Pipe Tunnel across the Milwaukee River

A 6-ft. pipe tunnel 216 ft. c. to c. of shafts, built recently under the Milwaukee River at Milwaukee, Wis., presents some interesting features of construction. It is adjacent to the Oneida St. power station of the Milwaukee Electric Railway & Light Co. and carries the company's electric cables and steam-service mains, providing connections across the river in the downtown district. It supplements two existing crossings, one near the same location and the other at the Commerce St. power station, several blocks north. The old tunnel at Oneida St. (crossing the river at an angle of 40° with the new tunnel) is of 4-ft. bell-and-spigot cast-iron pipe, with shafts of $\frac{7}{16}$-in. steel plate lined with 8 in. of brick. This tunnel is completely filled with conduits. It was built in 1898 and is in good condition.

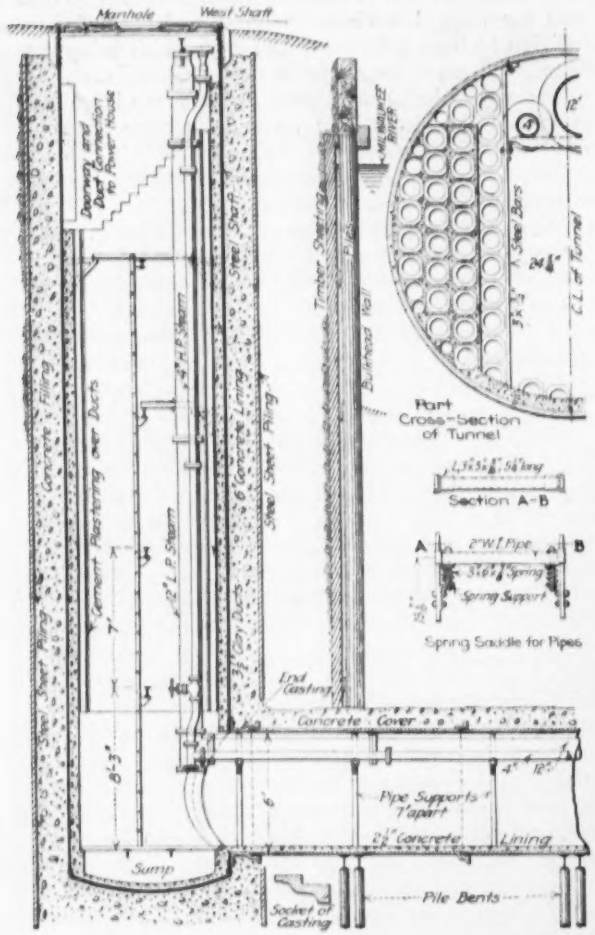


FIG. 1. SECTION OF SHAFT AND 6-FT. PIPE UNDER THE MILWAUKEE RIVER, AT MILWAUKEE, WIS., FOR THE MILWAUKEE ELECTRIC RAILWAY & LIGHT CO.

For the new crossing three methods were considered: (1) submarine cables; (2) a tunnel driven under compressed air and lined with concrete or cast iron; (3) a pipe tunnel, sunk in a dredged trench and connected to shore shafts. The first would not provide for the steam mains, and the second would have cost considerably more than the third, which was the method adopted. To provide ample safety from vessels, etc., it was decided to place the top of the pipe at about 29 ft. below datum and to protect it by a 12-in. cover of concrete. Fig. 1 shows the general construction of the tunnel and shafts.

At each shaft, the ground was excavated to the water level, and 45-ft. steel sheetpiles were assembled in a circle 11 ft. diameter, being set in place by a derrick car. The piles were then driven gradually to a level below the base of the shaft, a steam hammer slung from the boom of the derrick car working around the circle and driving each pile a certain amount each time. On the river side of this shell a rectangular extension was built in the same way, but driven only to a level above that of the top of the tunnel. This was to provide room for placing the connection casting. The inclosed earth was then excavated and a concrete bottom laid. Then the 8-ft. steel shell of the shaft (in one piece about 44 ft. long over all) was delivered on a scow, hoisted by tackle on a heavy gallows frame, and then lowered into the excavation, as shown in Fig. 2. The material excavated was mainly sand and gravel, but quicksand was found at one end.

The inner line of the sheeting on the river side of the shaft was then removed, and the connection casting lowered into place in the widened side of the shaft excavation, being then bolted to the steel shaft by two divers. Finally, the space between the shaft and the steel piling was filled with concrete. The steel piling forming the protecting wings on the river side was then removed, but

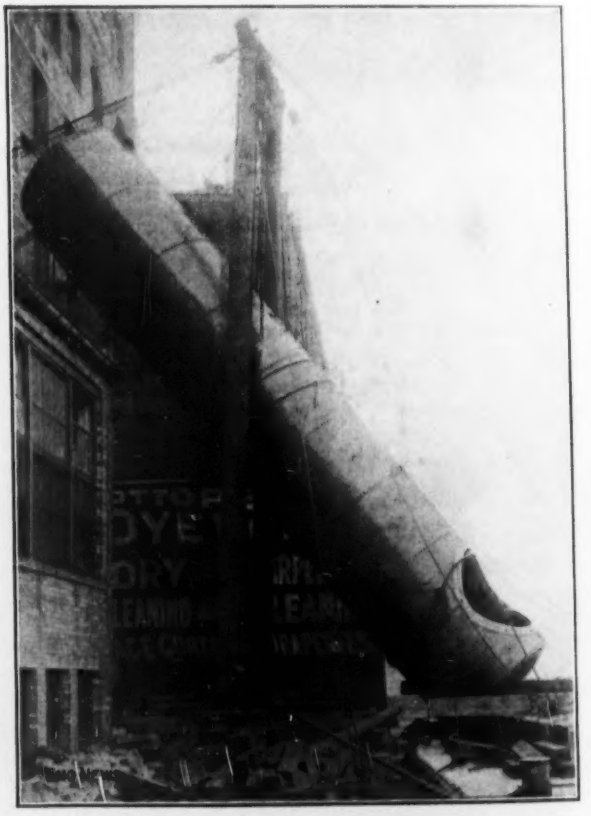


FIG. 2. STEEL SHELL OF SHAFT BEING PLACED IN POSITION FOR LOWERING INTO THE SHAFT EXCAVATION. (Shell 8 ft. diameter and 44 ft. long)

FIG. 3. LAYING PIPE SECTIONS FOR THE ONEIDA ST. TUNNEL UNDER THE MILWAUKEE RIVER; MILWAUKEE ELECTRIC RAILWAY & LIGHT CO.

(The view at the left shows a length of pipe connected and fitted with roller ways and end bulkheads ready for launching. The weight of the pipe sinks the outer end of the scow, on which rest the outer ends of the skids, thus lowering the pipe into the water automatically. The view at the right shows one of the floating pipe sections. The scow has two heavy inclined timbers supported on blocking, the projecting end of each timber carrying a chain block. The pipe is suspended from these blocks while being lowered into place. The barrels are to increase the buoyancy of the pipe, but were found unnecessary and were not used after floating the first pipe.)

this proved to be a tedious and troublesome task, necessitating the use of heavy tackle and jacking.

The tunnel consists of a line of 6-ft. cast-iron pipes in 12-ft. lengths. These were put together on the river bank in sections of about five pipes each, with the ends closed by wooden bulkheads, as shown in Fig. 3. Wood roller-ways were built around the pipes, and the section was then rolled down a set of inclined skids having one end resting on the dock wall and the other end resting on the outer side of a scow moored against the wall. The weight of the pipe depressed this side of the scow, so that the pipe section was automatically launched, its momentum giving it a rolling motion that carried it across the river. The first section had barrels lashed to it to increase its buoyancy (Fig. 3), but these were found unnecessary and were not used on the other sections.

The floating pipe section was then towed to a barge having heavy timbers projecting from the side, with hoisting blocks from which the pipe was suspended, as shown at the right in Fig. 3. Water was then admitted to the pipe and it was sunk into place, controlled by the suspending tackle. It was at first intended to let the pipes rest on the gravel bed of the dredged trench, but owing to the irregular and unstable surface this caused one of the pipe sections to buckle and open the joints. This section was taken to a dry dock to have the joints re-made, and was then floated back and sunk. To provide an even bearing, two-pile bents were driven in the trench, one at the location of the middle of each pipe, the piles being cut off to grade by divers, and capped with a pair of 10-in. I-beams, Fig. 1. After the tunnel was completed, the trench was filled with sand, pumped in by a suction dredge.

The method of laying the pipe sections is shown in Fig. 4. The five-pipe section at the west end was sunk first, and heeled into the slip joint of the connection casting on the shaft. This was followed by the adjacent three-pipe section, and then by another five-pipe section having a specially long slip joint (15 in.) near its center. The work was concluded by laying the five-pipe section at the east end (with filler piece to make the exact length). When this last was in place, the end piece of the long slip joint was pulled out so that its bell end inclosed the spigot end of the closing section of pipe, and was calked, thus completing the tunnel. The slip joints were fitted up by the divers. Their construction is shown in Fig. 4. All joints were made up on shore, the slip joints being pulled apart and recalked under water after reassembling.

To draw the pipes together at the slip joints, a band was put around the bell of one pipe, and around the spigot end of the other, this end having a bead or rib provided for the purpose. Each band was in four sections, flanged and bolted together. Longitudinal bolts 14 in. long were

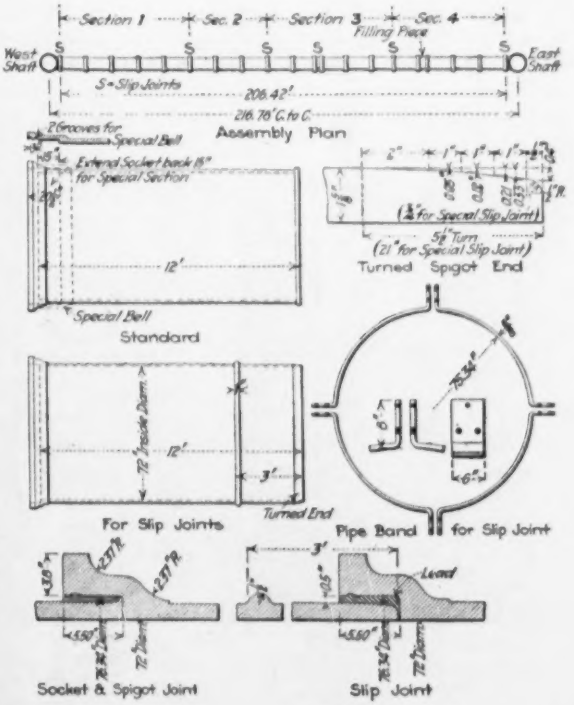


FIG. 4. CONSTRUCTION OF PIPE AND JOINTS, AND ARRANGEMENT OF PIPE SECTIONS AS SUNK IN PLACE

fitted between the flanges of these bands, and were screwed up by the divers, drawing the pipes into place.

The shafts have a 6-in. reinforced-concrete lining and concrete bottom (with sump at one shaft). Steel forms, built up of rings of segmental panels, were used in placing the concrete lining of the shafts. The tunnel has a concrete floor, with a space for a row of conduits on the bottom, and is packed with tile conduits on each side, as shown, leaving a passage about 2 ft. wide. Above this passage are the 4-in. and 12-in. pipes for high- and low-pressure steam. In the shafts, the conduits are arranged in a circle against the 6-in. concrete lining. The 12-in. concrete covering over the tunnel was laid by placing molded sections about 3 ft. apart and filling the intervening spaces with concrete lowered in a bottom-dumping bucket.

Work was commenced on Mar. 4, 1914, but the work was delayed by difficulties due to the treacherous nature of the river bed. The tunnel was pumped out on Sept. 4. The work of placing the shafts and tunnel, and covering the tunnel roof with concrete, was done by contract. The steel shafts and iron pipes were furnished by the electric company, which also did the lining of the shafts and all the interior work.

The tunnel was planned and built under the direction of the engineers of the company.

American Concrete Institute's Tests on Concrete Columns

SYNOPSIS—Résumé of tests made at the Bureau of Standards' laboratory at Pittsburgh on full-sized reinforced-concrete columns poured from concrete of building under construction. Longitudinally reinforced columns, hooped columns, plain columns and hooped columns with fireproofing layer were tested.

Large-size concrete column tests of wide scope were reported to the recent meeting of the American Concrete Institute by the Committee on Reinforced Concrete and Building Laws. A complete report may be obtained from the secretary, C. L. Fish, 1418 Walnut St., Philadelphia, Penn.; for those interested only in the general results the following abstract has been made.

The tests were made on columns poured from the materials and with the equipment used on a commercial building in New York City, using standard materials which successfully passed all the required tests. They were stored in the building under normal conditions for periods of three to seven weeks, and were then shipped to Pittsburgh where they were tested at the laboratory of the U. S. Bureau of Standards at periods varying from 101 to 126 days. Tests were under the general direction of the above named committee with the coöperation of various engineers, contractors and laboratories.

In all 24 columns were tested, having a variety of reinforcement both longitudinal and lateral, as indicated in the accompanying table and in Fig. 1. This variation was intended to give the following groupings: Columns 1 to 4, vertical steel the variable; columns 5, effect of increasing spiral; columns 6, effect of protective shell; columns 7, plain concrete; columns 8 to 10, no spiral reinforcement, effect of variation of vertical reinforcement.

All columns had a central shaft 9 ft. 4 in. long and about 21 in. in diameter (except columns 6 and 6a, which had an outer protective coating, making the outside concrete dimension 24 in.; the diameter of the spirals was fixed at 20 in. so that in all other hooped columns the protective coating was only just sufficient to cover the steel.) The section was spread at the top as shown in

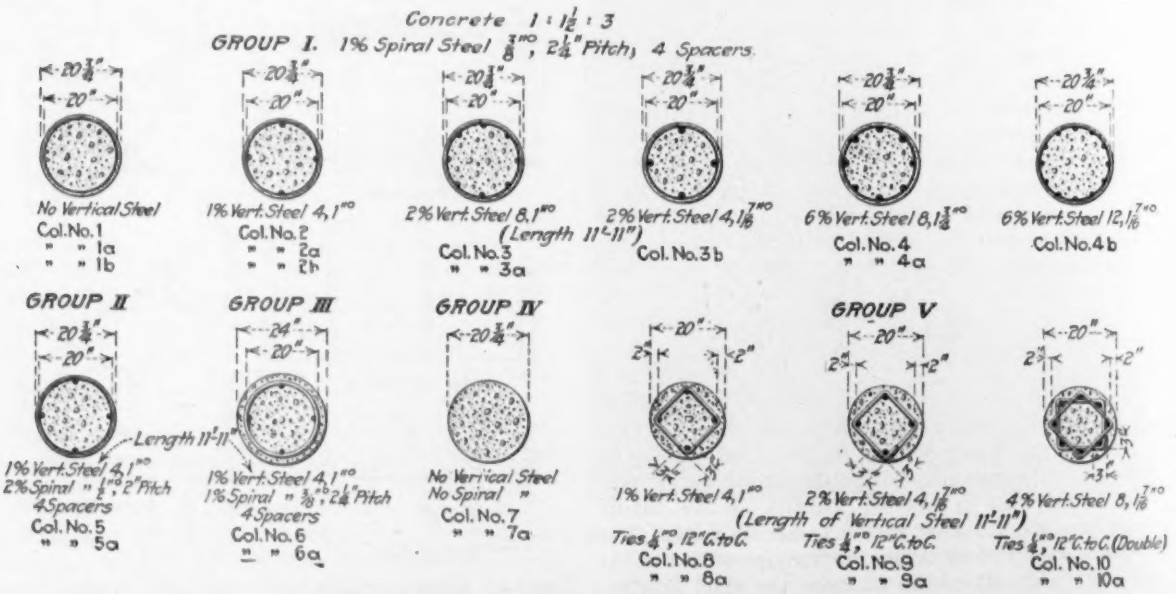


FIG. 1. SECTIONS AND DETAILS OF TEST COLUMNS

Fig. 2 in order to insure failure in the main shaft of the column. The concrete was a 1:1½:3 mixture. With each column two cylinders, 8 in. in diameter 16 in. long, were made for testing with the column, and results of these tests are shown also in the table. Additional test pieces were made for determination of other factors.

The reinforcement of the columns followed standard building practice, except that cast-iron bearing plates were located at the top and bottom of each vertically reinforced column so as to insure uniform bearing of the vertical rods at each end of each column. Subsidiary tests indicated that the concrete had a compressive strength in pounds per square inch as follows: seven days, 872; 28 days, 1966; 166 days, 2943.

In making the tests extensometer readings were taken on the gage lines indicated on the developed surface of the column shown in Fig. 2. These gage lines, it will be noticed gave both lateral and vertical deformation of both concrete and steel at critical points throughout the column.

The table herewith gives the résumé of the values obtained in the test. The conclusions which are drawn from the test may best be expressed in the words of the committee as follows:

PLAIN CONCRETE COLUMNS

The two plain concrete columns showed similar characteristics in the tests. No cracks or other signs of failure were visible until the maximum load was reached, except that in Column 7a a small longitudinal crack was seen in the shaft just below the head at a load of 750,000 lb. (2190 lb. per sq.in.). At the maximum load, longitudinal cracks developed all around the shaft of the column below the top of the head and extended down over the upper quarter of the length of the shaft. The action of Column 7a and its test cylinders in the test indicates that the strength of this column was below what would be expected with concrete having the average quality of that in the other columns.

COLUMNS WITH LONGITUDINAL REINFORCEMENT AND NO SPIRAL REINFORCEMENT

In the tests there was no marked sign of distress before the maximum load was reached. In some cases no crack was visible below the maximum load. In other columns a minute crack was found at 85 to 90% of the maximum load. Scaling of the longitudinal reinforcement at the gage holes where the bars were visible, was seen at loads below the maximum. In general the load fell off considerably a half-minute or so after the maximum load was applied.

The maximum loads carried by the columns are plotted in Fig. 5. The load taken by the longitudinal reinforcement is about 40,000 lb. per sq.in. The line shown in the diagram is expressed by the equation.

$$f = 3000\ (1 - p) + 4000\ p.$$

where f is the average unit load over the whole section, and p is the ratio of the area of longitudinal reinforcement to the area of the column. This formula in effect assumes that at the maximum load the concrete carries 3000 lb. per sq.in. and the reinforcement 40,000 lb. per sq.in., making n = 13⅓.

COLUMNS WITH SPIRAL REINFORCEMENT AND WITH AND WITHOUT LONGITUDINAL REINFORCEMENT

The load-deformation diagram of Column 3b given in Fig. 4 is typical of the hooped columns and will give an idea of the action of these columns.

The action of the hooped columns during the early part of the tests was similar to that of the unhooped columns. At a load near the maximum load which was carried by the unhooped columns having an equal amount of longitudinal reinforcement, the observed stress in the spiral was, say from 6000 to 8000 lb. per sq.in., an amount which may be expected to correspond to the lateral expansion of the columns under slight restraint. The effect of this restraint at these loads was slight, perhaps equivalent to 150 lb. per sq.in. vertical pressure in the columns with 1% spiral. The scaling of the longitudinal reinforcement where exposed at the gage holes was observed at loads similar to those observed for the unhooped columns.

Beyond the load which corresponds to the maximum load of an unhooped column the column shortened more rapidly with increase of load, the change in stiffness being very

RÉSUMÉ OF CONCRETE COLUMN TESTS

(In columns with ¼-in. spiral the pitch was 2 in.; in columns with ¾-in. spiral the pitch was 2¼ in.)

	Section			Spiral Reinforcement			Longitudinal Reinforcement				8x16 In. Cylinders, Average Strength	
Column No.	Age in Days	Diameter, In.	Area, Sq.In.	Kind	Per Cent.	Diameter, In., C. to C.	Kind	Per Cent.	Maximum Load, Lb.	Unit Load, Lb. per Sq.In.	Lb. per Sq.In.	Age in Days
1	101	20.84	341	¼-in.	0.94	19.95	none	0.00	1,621,500	4760	2868	104
1a	109	20.82	340	¼-in.	0.94	19.97	none	0.00	1,555,000	4570	3083	110
1b	119	20.86	341	¼-in.	0.94	19.95	none	0.00	1,774,000	5210	2885	119
Average										**4850**		
2	104	20.98	345	¼-in.	0.94	18.69	4 1-in. bars	0.91	1,626,000	4710	3393	103
2a	114	21.02	347	¼-in.	0.93	19.68	4 1-in. bars	0.91	1,700,000	4900	2773	115
2b	117	20.94	344	¼-in.	0.94	19.82	4 1-in. bars	0.91	1,766,000	5140	2860	117
Average										**4920**		
3	105	20.95	344	¼-in.	0.94	19.37	8 1-in. bars	1.83	1,737,500	5050	3185	105
3a	115	20.96	344	¼-in.	0.94	19.85	8 1-in. bars	1.83	1,647,000	4785	2575	115
3b	120	20.94	344	¼-in.	0.94	19.91	4 1 1/16-in. bars	1.89	2,025,000	5885	2675	120
Average										**5245**		
4	106	20.66	335	¼-in.	0.95	19.53	8 1¼-in. bars	5.75	2,069,000	6180	3095	106
4a	117	20.88	342	¼-in.	0.94	19.76	8 1¼-in. bars	5.63	1,968,000	5750	2670	116
4b	120	20.85	341	¼-in.	0.94	19.74	12 1 1/16-in. bars	5.71	2,165,000	6350	2775	121
Average										**6090**		
5	107	20.87	342	¼-in.	1.88	19.57	4 1-in. bars	0.92	2,060,000	6025	3035	107
5a	118	20.92	344	¼-in.	1.88	19.73	4 1-in. bars	0.91	2,223,000	6495	2883	118
Average										**6260**		
6*	113	24.09	455	¼-in.	....	....	4 1-in. bars	....	1,740,000	3825	3130	114
6a*	117	24.23	462	¼-in.	....	....	4 1-in. bars	....	1,720,000	3725	2768	120
Average										**3775**		
7	121	20.87	342	none	0.00	....	none	0.00	1,022,000	2990	2775	121
7a	124	20.96	344	none	0.00	....	none	0.00	860,000	2500	2518	125
Average										**2745**		
8	111	20.04	315	....	....	....	4 1-in. bars	1.00	1,040,000	3300	3308	111
8a	121	20.31	324	....	....	....	4 1-in. bars	0.97	1,360,000	4200	3098	121
Average										**3750**		
9	115	20.13	318	....	....	....	4 1 1/16-in. bars	2.04	1,150,000	3620	3458	113
9a	122	20.21	321	....	....	....	4 1 1/16-in. bars	2.02	1,206,000	3760	3055	122
Average										**3690**		
10	125	20.14	318	....	....	....	8 1 1/16-in. bars	4.08	1,451,000	4565	2835	125
10a	126	20.16	319	....	....	....	8 1 1/16-in. bars	4.07	1,436,000	4500	2940	126
Average										**4535**		

*Diameter of spiral = 20 in., Unit stress taken over whole concrete section.

noticeable, and the stress in the spiral increased very rapidly. The decreasing stiffness of the column was very marked, and at loads near the maximum the ratio of the added load to the added longitudinal shortening was for columns with 1% of spiral, say $^1/_{15}$ of that found at loads below the maximum load of an unhooped column. With continued increase of load the stretch of the spiral increased and beyond the yield point of the spiral reinforcement this stretch increased very rapidly relatively to the increment of load. As the maximum load was approached, the spiral stress was no longer uniform around the circumference, and it varied at different parts of the length of the column. Finally at some point the maximum strength of the spiral reinforcement was reached or the action of the column became very far from uniform, and the maximum load which the column would carry was attained.

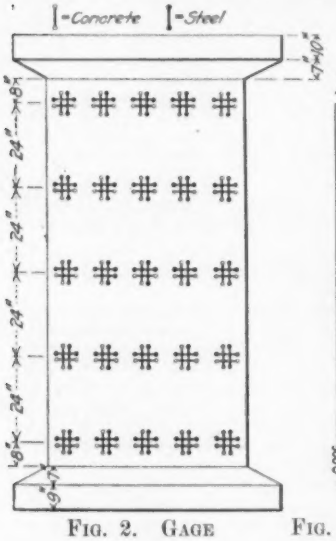


FIG. 2. GAGE LINES

(Developed surface of column showing gage lines)

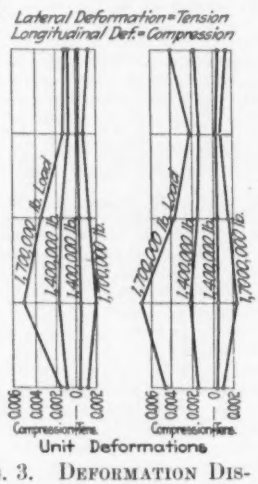


FIG. 3. DEFORMATION DISTRIBUTION

(Lateral and longitudinal deformation over column for two loads. Diagrams on left and right are for opposite faces)

There were few signs of distress or of approaching failure until near the maximum load. There were no spacing bars outside of the spiral to buckle. There was little or no spalling of the concrete outside the spiral, such as has been found in column tests when the coating outside the spiral was relatively much thinner. Fine vertical cracks usually appeared somewhat before the maximum load. Spalling occurred in one or more parts of the column—generally in several—either a little in advance of the maximum load or at the maximum load. The maximum load was held for some time, a minute or more. In many cases the spiral broke either at the maximum load, or at later and lower loads obtained by continuing to run the pump of the testing machine. The amount of shortening at the maximum load was generally about 0.004 in. per in. of length or more for 1% spiral and 0.006 in. per in. for 2% spiral.

In discussing the properties of the hooped columns, the question at once arises as to what part of the cross-section of the column is affected by the restraint of the spiral and whether the whole section acts to resist the load imposed on the column. The unit stress for any load will vary with the area of the cross-section used, and there will be a [illegible] difference between the value obtained by using core [illegible] and that found with area of the entire cross-section [illegible] column. The section which gives the proper interpretation of the action of the column is wanted in this study rather than the section which should be used in designing columns. Below the loads at which the spiral exerts an important effect, the conditions are similar to those of an unhooped column, the full cross-section should be used, and a proper interpretation will involve the use of unit stresses calculated on this basis. For loads which give marked stresses in the spiral it is obvious that all or nearly all of the area within the spiral will be fully restrained.

It seems evident that an area outside the spiral may be acted upon similarly, the restraint being carried by the shearing and tensile resistance of the concrete. For the columns in question the space entirely outside the spiral amounted generally to about ⅝ in., that is, a space equal to the diameter of the spiral reinforcement for the 1% spirals. These columns showed no spalling up to nearly the maximum load. Calculations and diagrams made by using the core area only gave results which are inconsistent among themselves and not satisfactory in the interpretation of the data. The area of the gross section may be somewhat greater than the area which is effectively restrained, but it cannot be far from the right one. The unit stresses so found are smaller than would be obtained otherwise and the variation from the real effective section will partly make up for the possibility of having used for the ultimate loads values somewhat greater than may be warranted by the plastic quality which occurs in a hooped column near its maximum load and when the spiral has been stressed beyond its yield point. It seems best, therefore, to use the gross area of the cross-section of the hooped columns. This should not be taken to have a bearing upon what section should be used in designing columns.

In the accompanying table, the average unit loads given are based upon the gross section of the columns. In Figs. 5-6 the plotted values are also based on the gross section.

From Fig. 5 it is apparent that the additional strength given by the longitudinal reinforcement is less in the case of columns with spiral reinforcement than in columns without spiral reinforcement. For loads beyond the resistance given in unhooped columns, it would seem that the longitudinal bars may offer little or no additional resistance, and that the lateral swelling of these bars may increase the stress produced in the spiral reinforcement without giving corresponding increased strength to the column.

In any study of the results attention may well be called to the abnormally high strength of Column 8a, which is inconsistent with the other tests. Except for this column, the results are fairly consistent among themselves. The lines drawn on Figs. 5-6 represent the equation

$$f = 3000\,(1 - p) + 40000\,p + 160000\,(1 - 10\,p)\,q.$$

where f is the average unit stress over the whole column section, p is the ratio of the area of the longitudinal reinforcement to the area of the column section, and q is the ratio of the volume of the spiral reinforcement to the volume of the column. As the columns with 2% spiral reinforcement contain only 1% longitudinal reinforcement, there is nothing in the tests to show that this equation properly expresses the effect of longitudinal reinforcement in connection with 2% spiral reinforcement. The formula, however, brings out a probable limitation on longitudinal reinforcement in hooped columns. Such a formula is limited by the range of the test

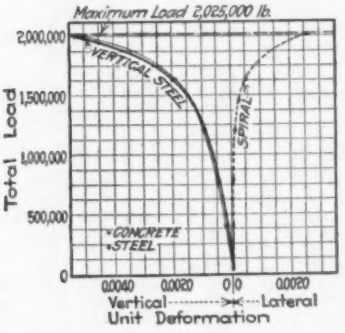
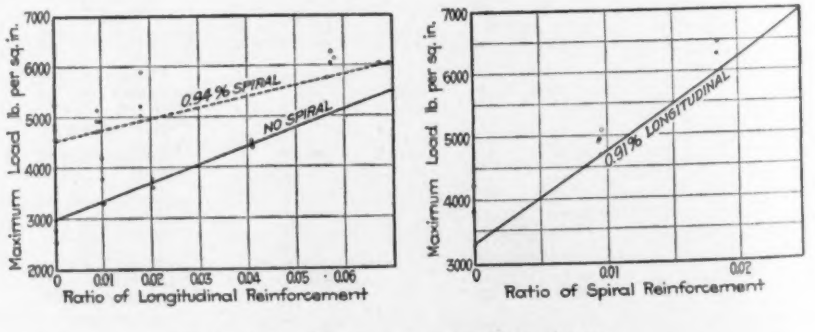


FIG. 4. TYPICAL DEFORMATION CURVE

(Stress deformation curves at central plane of Col. 3B)



FIGS. 5-6. CURVES OF ULTIMATE LOADS

(Fig. 5. Longitudinal reinforcement variable. Fig. 6. Spiral reinforcement variable)

variables, and it should be noted that the largest amount of spiral reinforcement in these tests is 2%.

In discussing the results of the tests and in studying the diagrams in Figs. 5-6, it may be well to take into consideration the area of the spacers as affecting the percentages of longitudinal reinforcement and the applicability of the formula.

The strength given by spiral reinforcement is larger than has been found in other tests which have been reported previously. In judging the results of the tests it should be borne in mind that these are short columns (less than six diameters between heads), that the spiral reinforcement was well made and properly placed, that the columns were straight, and that the loads were applied in such a way as to produce little bending moment in the columns. It has been shown by tests that irregularity of pitch and inclination of spiral produce the same effect as crookedness and may reduce the column strength.

In the discussion above, maximum loads are used and the values given are the ultimate strengths of the columns. A study of the load-stress diagrams made up from the data indicates that for any column the additional load due to the hooping is nearly proportional to the stress in the spiral reinforcement. This holds up to a stress of, say 85% of the ultimate strength of the spiral reinforcement, when a marked variation in the stresses develops in different parts of a section. Rapid increase of stress at some point soon follows.

COLUMNS WITH FIREPROOFING LAYER

The two columns with a thickness of about 2 in. of concrete outside the spiral were tested to determine the action of the fireproofing layer or protective shell under high loads. The action of the column through the first part of the test was similar to that of an unhooped column. At the maximum load the longitudinal deformations were about those of an unhooped column at its maximum load, somewhat less than the usual amount at most points of measurement, but reaching the usual amount at others. Up to the maximum load no cracks or other signs of distress were visible. At the maximum load the shell or layer outside the spiral rapidly cracked in various places in the upper portion of the column shaft, the load fell about 10% and the fireproofing shell dropped off from this portion, either at the maximum load or a little later with a continued movement of the testing machine. With further movement of the head of the testing machine, and a corresponding shortening of the column, the load again increased and rose nearly to the original maximum load. During this time the spiral reinforcement in the exposed portion stretched as is usual with a hooped column, and the second maximum was that to be expected with a hooped column having a section corresponding to the outside diameter of the spiral.

It may be noted that the relation between the area of the gross section of a column having a given thickness of fireproofing, and the area of the section inclosed by the spiral will depend upon the size of the column. For these columns, the load carried after the fireproofing layer failed was nearly as much as that which caused the failure of the outer shell. For larger columns (with the same thickness of fireproofing and same percentage of reinforcement) the maximum load carried by a hooped column would be larger than the load which would produce failure of the fireproofing layer. For smaller columns the reverse would be true.

Conclusions

The results of these tests warrant the following conclusions by the committee:

1. They seem to confirm the current practice as to the effect of varying percentages of longitudinal reinforcement within the range of these tests as expressed in the following formula:

$$f = f_c (1 - p) + n f_c p$$

2. They indicate that columns with spiral reinforcement are stronger and tougher than columns with no spiral reinforcement.

3. For these tests it would appear that the spiral reinforcement is approximately four times as effective in giving ultimate strength to the column as the same volume of longitudinal reinforcement.

4. It appears that the effect of the longitudinal reinforcement decreases as the percentage of spiral reinforcement increases.

Operations of the Cleveland Garbage-Reduction Works

The operating results of the garbage-reduction works of Cleveland, Ohio, are always of interest, because that city was the first one to break into a field previously controlled by private companies, and because of the good management of the plant. Through the courtesy of Fred W. Cummings, Superintendent of Garbage Reduction, we are enabled to present the following figures relating to the operations of the works for the last two calendar years, as given in Mr. Cummings' forthcoming annual report for 1914:

Tons of garbage collected in 1914	55,730
Tons of garbage collected in 1913	52,354
Increase	3,376
Lb. of grease produced in 1914	3,290,105
Lb. of grease produced in 1913	3,238,116
Increase	51,989
Tons of tankage produced in 1914	5878.5
Tons of tankage produced in 1913	5099
Increase	779.5

	In 1914		In 1913	
	Total	Per Ton	Total	Per Ton
Cost of reduction	$141,415.12	$2.5373	$113,057.34	$2.16
Earnings of reduction	194,585.57	3.4916	157,010.81	3.013
Net earnings	53,170.45	0.9543	43,953.55	0.853
Depreciation	12,924.52			
Gross earnings	66,094.97			
Cost of collection	164,769.52		142,584.38	
Loss on live stock	1,089.00		1,088.50	
Cost of reduction	141,415.12		113,057.34	
Total cost	307,273.64	5.3135	256,730.22	$4.904
Total earnings	195,221.35	3.503	157,705.49	3.013
Cost over earnings*	$112,052.29	2.0105	99,024.73	1.891

*Appropriated out of general fund by the city.

Eight collection routes were added during the year, making 90 routes. An auto truck to collect from apartment houses and restaurants was put on. Average collections, twice a week. Average daily collection during year, 360,711. Complaints, 5093 in population of 700,000. Total of 471 pieces of silverware found in garbage cans and returned to owners.

The following analyses of tankage and of grease, as determined by the city chemist, are from samples collected from two carload lots of each on Feb. 10, 1915.

(Percentages of Total Sample)

	Moisture	Fat	Ammonia	Potash	Bone Phosphate	P_2O_5
Tankage (a)	2.77	1.45	3.89	0.69	12.95	5.43
(b)	4.61	1.70	4.04	0.75	12.40	5.68
	Moisture	Hydrocarbon		Dirt	Total Impurities	
Grease (a)	0.61	2.84		0.10	3.55	
(b)	0.51	2.80		0.10	3.41	

The contract price per ton for tankage is based on the following unit (parts in 100) prices of fertilizing value, as shown by analysis: Ammonia, $2; potash, $0.70; bone phosphate, $0.10. Thus, sample (a) would yield: $(3.89 \times \$2) + (0.69 \times \$0.70) + (12.95 \times \$0.10) = \$9.555$ (*f.o.b. at plant*)

The grease now brings $4.37 per 100 lb. (f.o.b. plant), with a deduction for moisture and for unsaponifiable matter.

The grease contract expires on Apr. 1, 1915, after which the price will probably fall, on account of the decreased foreign demand since the European war began. The present grease contractor is the Will & Baumer Co., Syracuse, N. Y., manufacturers of red oils, glycerin, candles, beeswax and stearic acid.

The Library of a Famous American Engineer has been placed in the collection of the Massachusetts Institute of Technology. This is the collection of Loammi Baldwin, comprising 2200 volumes, many of which were bought in Europe in the early part of the past century, and were said to make the most complete working library of engineering in America at that time. Loammi Baldwin occupied a place in American civil engineering similar to that of Smeaton and Rennie in Great Britain.

Reconstruction of the Austin, Texas, Dam

The reconstruction of the dam across the Colorado River at Austin, Tex., is about completed. It will be remembered that on April 7, 1900, the masonry dam at this place failed under an 11-ft. flood flow over the crest, a length of some 550 ft. of the 60-ft. high structure being swept out bodily.*

Since 1910, negotiations have been in progress between the city and various interests looking toward the reconstruction of the dam with the consequent creation of a lake above the city and the installation of a power house. Considerable mystery has surrounded these negotiations, and a most curious reticence has prevailed in connection with the design and construction of the new work, so that full information regarding the present dam has not been available. We give here, however, a few views of the rebuilt dam and such a description of it as is possible from the information now at hand.

In the reconstruction about 450 ft. of the old dam was left standing at one side and nearly 80 ft. at the other and the intervening 560 ft., which was practically the opening left by the washed-out portion of the dam, has been replaced by a hollow reinforced-concrete structure. The old dam was 65 ft. high. The new portion is built with a section 56 ft. high, but with 14-ft. automatic flashboards which are continued on a level across the old portion of the dam, but are there only 5 ft. high. Thus the dam with its flashboards is capable of raising the water level above it to a height of 70 ft., but when the flashboards are down, the spillway crest over the new section of the dam 560 ft. long is 9 ft. lower than the spillway over the old part of the dam.

The flashboard gates are shown in Fig. 3. They swing on horizontal trunnions and are so designed that when the water is at the head of 70 ft. the gates will be in equilibrium, but a few inches extra height will cause them to tip and allow the water to flow freely over the spillway at the lower level.

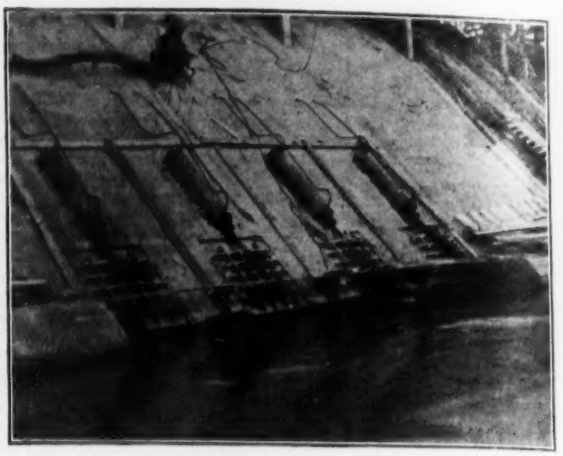


FIG. 2. PISTONS OPERATING SLUICE GATES ON AUSTIN DAM

Sluice gates are provided near the bottom of the dam to facilitate cleaning out the silt which rapidly accumulates in the lake behind the dam lake bed. These gates are operated by hydraulic pressure from the power house. The power house is on the Austin side of the river, and its turbines are so located that the water may be used down to 18 ft. below the crest of the dam. Power will be generated by three vertical turbines, having each a normal capacity of about 2500 hp. at 60-ft. head.

Fig. 1 is taken looking upstream just before the final closure of the reinforced-concrete section. That part to the right is the new reinforced-concrete dam, the portion to the left is the old masonry dam with the new flashboard supports in place. Fig. 3 shows a near view

*A list of nearly 50 references to the history of the Austin dam will be found in "Engineering News," Apr. 14, 1910, p. 440.

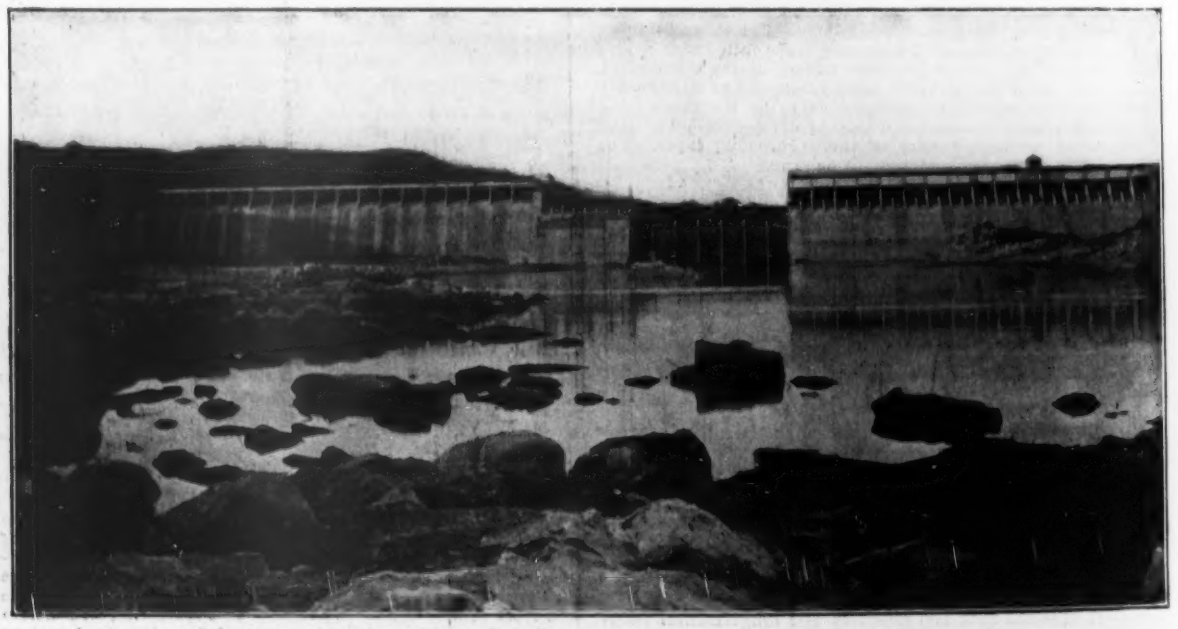


FIG. 1. THE AUSTIN, TEXAS, DAM SOME MONTHS BEFORE COMPLETION

(Looking upstream; old masonry section with 5-ft. flashboards on left; new reinforced-concrete section on right)

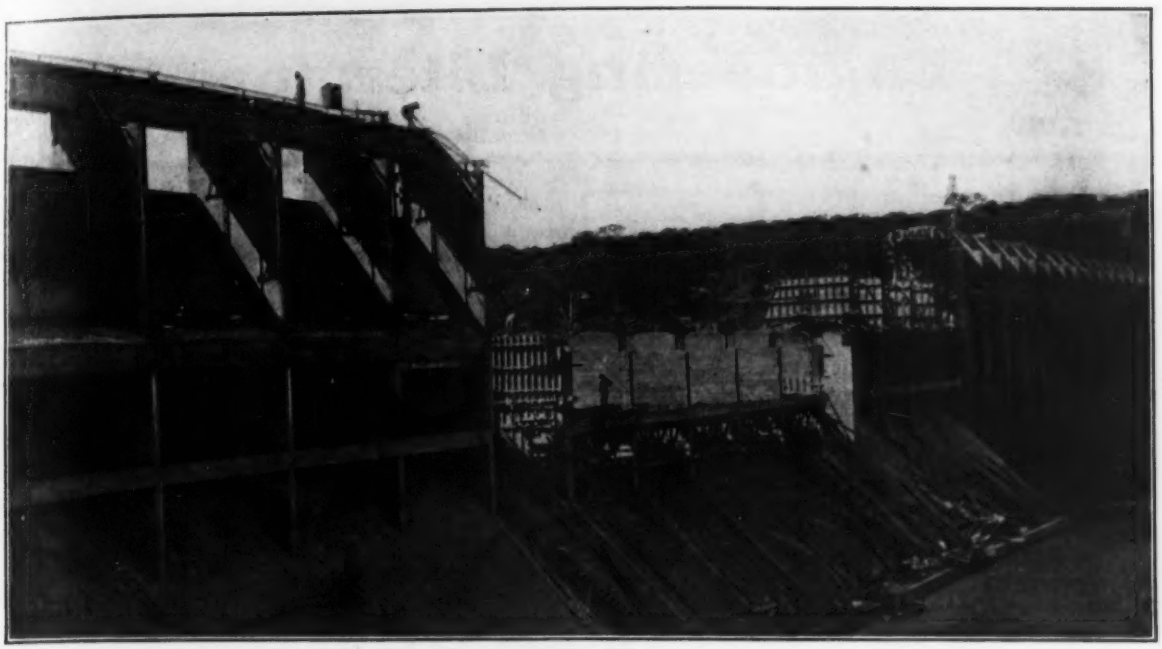
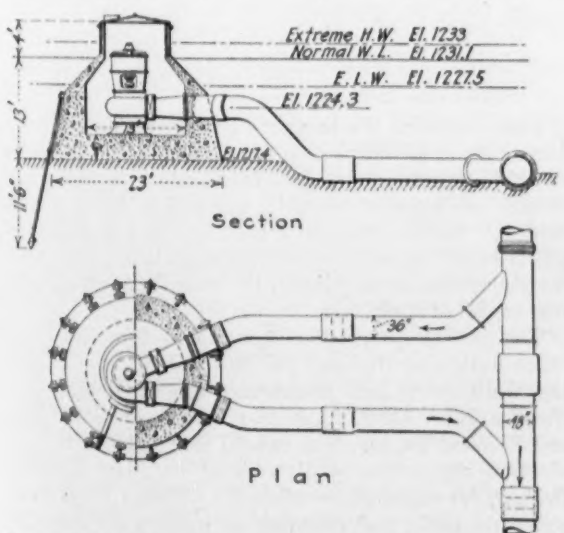


FIG. 3. UPSTREAM FACE OF AUSTIN DAM, SHOWING FLASHBOARDS AND FINAL CLOSURE OF CONCRETE SECTION

of the flashboards and, just beyond, the connecting section between the reinforced-concrete and the masonry structure. Fig. 2 shows the operating pistons of the sluice gates.

A Submerged Pump Crib Pinned Down with Screw Piles

The water-supply of the city of Geneva, Switzerland, is taken from Lake Geneva a mile and a half out from shore in 50 ft. depth of water. A 48-in. suction line extends from the pumping station about 2 mi. out to the intake. Considerable loss of head in the suction pipe reduced the capacity of the system, and also had a tendency to draw in mud through any defective joints of the main. A submerged suction-booster pumping station has been installed ½ mi. out from the main station, as described a few months ago in "Le Génie Civil." The pump is contained in a caisson seated directly on the lake bottom, a structure whose shape and method of fastening are equally novel.



SUCTION-BOOSTER PUMPHOUSE FOR GENEVA WATER-SUPPLY

The caisson (see sketch) is a simple concrete-lined steel shell with base 23 ft. in diameter and total height 18 ft. At lowest water the structure with the 65-hp. motor and pump contained in it produces a loading on the bottom not higher than 200 lb. per sq.ft. The bearing power of the lake bottom had been determined by prior test to be in excess of half a ton per sq.ft.

The caisson was built on shore, and when completed was launched like a boat, floating, and sunk. It is retained in place by 16 screw piles sunk into the bottom through pairs of loops or stirrups fastened to the outside of the shell.

The pump, running at 200 r.p.m., has a capacity of 1,100,000 gal. per hr., with 10-ft. lift. The motor is a polyphase induction motor operating on current at 2000 volts, 40 cycles.

One-Way Streets Were Introduced in Boston some years ago to relieve serious traffic congestion on certain narrow ways. Some opposition was encountered at first, but experience has proved the wisdom of the move, as traffic utilizes street surfaces to immeasurably better advantage if it all moves in one direction. It is said that two-thirds of all the automobile traffic between down-town Boston and the western and southern suburbs uses Beacon St., causing such congestion and such frequent blockades that the Board of Street Commissioners has been forced to consider the advisability of including it, and some adjacent streets, in the number of ways on which traffic is limited to one direction. A tentative plan has been drawn up, but no date has yet been set for the public hearing which will be held before the new regulations are enforced. Those streets upon which one-way traffic is now required are marked by inconspicuous signs, the one at the entrance end reading "Vehicles must go in the direction of the arrow," and the one at the outlet end reading "This is a one-way street. Do not enter here."

Engineering Literature

EDITORIAL

More and Better Books

Greater activity in the publication of technical books is apparent after months of dullness. At another time, a mere addition to the number of books might not be a cause for rejoicing but just now it is one of many signs of increasing business confidence. An added reason for congratulations all around—to authors, publishers, readers, and reviewers—is the fact that a goodly number of the new books are of more than usual importance and merit as to subject matter and manner of treatment.

Although everyone knows that technical books, even in periods of dullness, have long been pouring from the presses in great number, our readers will doubtless be surprised to learn that, in the dozen years since the Engineering Literature section of this journal was started, over three thousand books and reports of sufficient importance to be entered in our card catalog have been noticed in these columns. In addition, thousands of minor volumes have been given briefer mention or have been merely listed under Publications Received.

The function of these columns has been and is two-fold: (1) To give the technical-book news of the day, and (2) to present an estimate of the probable value of such books to those for whom they are intended. In fulfilling the critical function, the editors of ENGINEERING NEWS have been assisted by a large number of engineers, and other technically-trained men, each chosen for his special knowledge of the field traversed by the book to be assigned for review. The list of outside reviewers now exceeds two hundred. These men have been chosen from every branch of the engineering and allied professions and from Maine to Texas and California. To their hearty coöperation the editors and readers of these columns are alike indebted. With their aid we shall continue to encourage the production of better and, so far as may be needed, of more books for engineers.

A Useful Bibliography

An interesting illustration of how much a thorough expert search can reveal of published data on an engineering subject is furnished by a pamphlet just issued by the Carnegie Library, of Pittsburgh. It is a bibliography of "Air Conditioning" material available in the Pittsburgh Carnegie Library. No references are included to the ventilation of mines, subways and railway cars, nor to the cooling of air for cold storage or other industrial operations. The pamphlet contains, however, 35 pages, averaging perhaps 14 references per page, or a total of nearly 800 articles, relating to the single subject of air conditioning of buildings. The references are classified under the heads of Bibliography, Patents, Trade Publications, Directories of Manufacturers, General Principles, Hygienic Aspects, Conditioning for Industrial and Mechanical Purposes, Humidity, Measurement and Control, Humidifiers, Air Filters, Air Washers, Air Cooling, Temperature Regulation, etc.

Air conditioning is comparatively a new art, as is evidenced by the fact that there are very few references given to articles published earlier than 1900, and by far the most numerous references are to publications of the last few years. Yet this comparatively new art has already had enough published about it to make in itself a library of respectable size.

It is worth noting that the education of every engineering student should include training in the art of finding out for himself what has been published on a given subject. Occasionally, he may have the good fortune to find a complete bibliography, as in the case of this pamphlet on air conditioning. More often he will have to go to a library, either his own or the best available reference library, and find out there, from the available indexes, what has been published bearing on the problem he has to solve.

The number of bibliographies and less pretentious finding lists is already large, and is increasing so rapidly that the investigator who has access to a good general or technical library will do well to find out whether or not his needs have already been met before he makes up a list of his own.

REVIEWS AND NOTES

For Structural Engineers

REVIEWED BY JOHN C. MOSES*

STRUCTURAL ENGINEERS' HANDBOOK: Data for the Design and Construction of Steel Bridges and Buildings—By Milo S. Ketchum, M. Am. Soc. C. E., Dean of the College of Engineering and Professor of Civil Engineering, University of Colorado. New York and London: McGraw-Hill Book Co., Inc. Flexible leather; 6x9 in.; pp. xv + 896; 400 illustrations. $5, net, postpaid.

STRUCTURAL STEEL DRAFTING AND ELEMENTARY DESIGN—By Chas. D. Conklin, Assoc. M. Am. Soc. C. E., In Charge of Structural Design, Cooper Union Schools, New York City. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 9x12 in.; pp. vii + 154; 151 illustrations. $2.50, net.

Dean Ketchum has brought together in this volume a large amount of information for the designer and builder of steel structures. He does not, however, consider the special problems of movable, suspension or cantilever bridges. He has produced a book for the practicing engineer rather than the student, although it is a good book for the student to acquire on the completion of his regular course of study.

The first eleven chapters take up in turn, Mill and Office Buildings, Highway and Railroad Bridges, Retaining Walls, Piers and Abutments, Timber Bridges and Trestles, Bins, Elevators, Mining Structures, Standpipes and Elevated Tanks. The general plan followed in each of these chapters is similar. That on Steel Railroad Bridges, for example, describes the different types used, and gives tables and diagrams of weights for spans of

*Engineer of Construction, The Boston Bridge Works, Inc., Cambridge, Mass.

varying lengths, taken from the practice of several prominent railroads and bridge companies. Several systems of live loading are described, with tables of moments and shears for Cooper's loading. Impact formulas and the conditions for maximum stress are discussed. A page is given to the economic design of railroad bridges, in which the author prophesies a return to pin-connected trusses for spans over 200 ft. in length. Types of timber and ballasted floors are illustrated and the waterproofing methods and specifications of several railroads are given. A number of pages are devoted to detail drawings of plate girders and truss bridges. These examples seem well selected and are very clearly printed without resort to insert plates, as are all the tables and illustrations throughout the work. The specifications of the American Railway Engineers Association are given in full and an interesting comparison is made with sixteen other specifications in extensive use. The instructions to draftsmen issued by one of the railroad companies follow and the chapter closes with a list of references to books on stresses and design.

The chapters on Mill and Office Buildings, on Highway Bridges, and on Mine Structures are largely abstracted from the author's well known works on these subjects, although much new materia[1] is included. All follow the general method of treatment illustrated above. Those on Retaining Walls, Bins, and Elevated Tanks give the formulas for finding the stresses, in addition to the general data, examples and specifications. Here again the author has given us an abstract of one of his previous books, to which we are referred for fuller details. All these chapters are profusely illustrated with examples and tables, the standards of prominent bridge companies and railroads being frequently reproduced. The entire book, in fact, is an interesting example of the growing tendency to reduce all ordinary designing to "standard practice," with its resulting economy and safety.

The author emphasizes in his preface the need of the designer for a knowledge of methods of construction and erection and their effect on costs, in order to produce an efficient structure. He has therefore included interesting chapters on Structural Drafting and Erection, making use largely of the instructions issued by certain bridge companies to their men.

A chapter on Engineering Materials defines the different kinds of metals and gives in full many of the specifications of the American Society for Testing Materials. Specifications for cement and concrete are also given, and there is a brief discussion of corrosion and paints. There is also a chapter on Estimating, with sufficient cost data to give the designer a general idea of the subject, and this is wisely all that is attempted. Chapter 16 gives a résumé of the definitions and formulas of structural mechanics as applied to beams and trusses, and Chapter 17 considers the design of individual members and connections, with examples.

The last third of the book is devoted to tables of properties of rolled and built-up sections, and to general information. The tables of properties of built-up chord and column sections are original and very complete. Most of the other tables are those found in the mill handbooks. They are well arranged for ready reference and make the book complete in itself, although adding a good deal to the bulk of an already weighty volume.

The structural engineer will find this book a convenient summary of what he has had to look for, in the past, in numerous textbooks and periodicals. He will be reminded of many matters he might easily overlook if taking up a problem not usually dealt with, and he will be informed of recent developments, and find useful references to books and articles dealing more fully with special subjects. He cannot fail to be delighted with the excellence of its mechanical make-up and of its illustrations. The book is a notable one and worthy of a place on the desk of every structural engineer.

Detailing structural steel work has become standardized to such a degree in recent years that it is now possible to publish books of instruction for draftsmen that are of general applicability. Prof. Conklin's book is one of several that have recently appeared, but aims to teach, not only the method of making drawings that is used by manufacturers of structural material, but also the elements of design.

The first chapters give a general description of the organization and duties of the drafting and estimating departments, and of the usual arrangement and equipment of the drafting room. Methods of lettering and shop marking are described, and rules for ordering material are given. After some discussion of the detailing of elementary pieces and the design of riveted connections, the author presents as examples a small building, a roof, deck and through plate-girder bridges, and riveted trusses for highway and railroad use. The student is shown how the stresses are obtained, and then the size of each member is found, and every step in detailing the joints is fully given. The complete shop drawings are then given, with comments on the proper arrangement of views, dimensions, shop marks, etc. Hip and valley work is briefly touched upon in the final chapter. An appendix contains the Standard Specifications for Steel Railroad Bridges of the American Railway Engineering Association.

The author's method of combining his two subjects is fairly successful when applied to the design of the details that are usually worked out by the drafting department, but is open to considerable criticism when he tries to explain the calculation of the main stresses in girders and trusses. It would seem wiser to assume the stress sheet computed as it comes to the draftsman in actual practice, and not to confuse the student with mathematical discussions which only a thorough technical education can fit him to pursue understandingly. While drafting is a necessary part of the training of every engineer, there are also many men that engage in it as a permanent occupation, acquiring the necessary knowledge in evening and trade schools, or as apprentices in drafting rooms. This book is adapted to the needs of this class of students and would furnish a good course for an evening school or for private study if portions of the chapters on general design were omitted. That part of a design is not done by draftsmen but by the engineering or estimating department, and very few men can successfully do both things.

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Under the title "Gate Structures for Irrigation Canals" (Bulletin 115, U. S. Department of Agriculture, Washington, D. C.), Fred C. Scobey, Irrigation Engineer, Irrigation Investigations, has brought together a

useful collection of designs of the various kinds of gates used to control the flow of water in irrigation canals and ditches. Accompanying text deals with materials of construction, the types of gates and the elements of their design. Many actual installations are described and illustrated by drawings and halftone views. Most of the gates dealt with are of medium size.

Sewer Construction

REVIEWED BY JOHN H. GREGORY*

AMERICAN SEWERAGE PRACTICE: Vol. II, Construction of Sewers—By Leonard Metcalf and Harrison P. Eddy. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. x+564; 181 illustrations. $4, net.

The second volume of "American Sewerage Practice," devoted to construction, is a fitting complement to Vol. I, on design. The two volumes together, leaving out the question of sewage disposal, cover admirably the whole field of sewer design and construction, as viewed from the standpoint of the best American practice.

The authors first take up the subject of preliminary investigations and point out what data are required and how they may be secured. Although the authors state that the chapter was prepared mainly for students, young engineers and inspectors, yet experienced engineers will find therein many helpful suggestions.

Engineering work and inspection during construction are next considered in more or less detail. Methods of staking and laying out work are given, and attention is called to the need of careful inspection of materials and workmanship. Measurements and estimates are treated briefly. The securing of records during construction and methods of cost keeping are, however, considered more at length, and tables and diagrams are given to illustrate how field, cost and progress notes and records are kept.

Two chapters are devoted to earth excavation and machinery used for excavating trenches. The removal of excavated materials by hand and methods employed in tunneling are first described, as well as pumps for, and methods of, removing water from trenches. The use of trench machines is then taken up and also the use of cableways, steam shovels, drag scrapers, derricks and cranes for excavating material. An excellent description of the construction and use of the Carson trench machine, one of the oldest and best known, is given.

Methods of excavating rock and explosives and blasting are discussed next. Different types of hand and power drills, and their use, are well described, and data on the cost of both hand and power drilling are given. The chapter on explosives and blasting deals with the composition, handling, use, shipment and storage of various kinds of explosives, and is an especially interesting one, and well worth reading carefully by those having in any way to do with the use of explosives.

The two chapters on the quantity and cost of excavation and on the rate of progress in building sewers, to which 63 pages are devoted, are perhaps best read together. In them the authors give extended and valuable tables covering the cost of earth and rock excavation, of concrete and steel, and the rate of progress in building over fifty miles of concrete sewers, of various sizes, constructed by contract in Louisville, Ky., from 1907 to 1912. A careful study of these tables will give the reader a very fair idea of what can be accomplished, under conditions similar to those encountered at Louisville, by an efficient engineering organization. Useful tables and diagrams giving the volume of excavation for various widths and depths of trenches are also included.

The sheeting and bracing of trenches and tunnels and the sizes of sheeting, rangers and braces, are given in two chapters. Both subjects are well treated, from the theoretical as well as the practical point of view, and numerous examples and illustrations of different methods of sheeting and bracing are given. The use of sheet-steel piling as sheeting is also touched upon. Of much value are the tables and diagrams from which both the sizes of rangers and braces and the quantity of lumber required for sheeting and bracing typical trenches may be obtained.

A chapter is devoted to the purchasing, handling and laying of sewer pipe, and information is given on the price of pipe as well as instructions for testing, handling and storing pipe. The laying of and backfilling around pipe is next considered, and tables and diagrams are given for estimating the cost of laying pipe sewers under different conditions. Methods used in laying large concrete pipe, cast-iron pipe, steel pipe and pipes under water are also given.

In the chapter on jointing sewer pipe, the authors discuss the making of joints with cement, sulphur and sand, asphalt, and tar, and also with some of the special compounds which have been put on the market. The advantages and disadvantages of the different kind of joints are pointed out and the testing of pipe after laying is briefly mentioned.

Two chapters (49 pages) are devoted to the construction of brick, vitrified-block, concrete-block and concrete sewers, and several tables and diagrams are given for estimating the volume of material required for and the cost of construction. The relative value of mixing concrete by hand and by machine is discussed, and also waterproofing, work joints, disintegration due to chemical action and the placing of concrete in freezing weather.

One of the most interesting chapters in the book is that on profiles, templates, forms and centers for brick, stone, block and concrete sewers. Many types of wooden, metal-covered and steel forms are illustrated, and data are given on the cost of constructing and handling such forms. The lubrication of forms and the time forms should be left in place are also discussed.

To the subject of contracts, specifications, drawings and technical specifications the authors devote 58 pages. They discuss the general form of engineering contracts, insurance, the different kinds of contracts, liquidated damages and bonus clauses, and give a typical form of contract used by them. They then give a set of technical specifications covering the different classes of work ordinarily embodied in sewer specifications, which the authors believe to be representative of the general opinion of sewerage specialists in 1914.

Under the operation and maintenance of sewerage systems the authors call special attention to the lack of appreciation on the part of the public, and of many city officials, of the necessity for properly maintaining a sewerage system so that it will be at all times ready to perform its functions. Data are given on the cost of maintaining sewerage systems in various cities, the figures for Worcester, Mass., being especially noteworthy.

The last chapter, dealing with sewer explosions, is

*Consulting Engineer and Sanitary Expert, 170 Broadway, New York City.

timely. In it the authors discuss the causes of explosions and describe briefly some of the most serious explosions which have occurred.

The book is uniform in appearance and make-up with Vol. I, is well illustrated with numerous carefully prepared drawings and half-tones, and should be of great value to contractors as well as to engineers.

Design of Simple Structures

REVIEWED BY LEWIS E. MOORE*

STRUCTURAL DESIGN: Vol. II, Design of Simple Structures —By Horace R. Thayer, Assistant Professor of Structural Design, Carnegie Institute of Technology. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. ix + 495; 160 illustrations. $4, net.

This book is a continuation of Vol. I, "Elements of Structures," by the same author.† The chapter and article numbering is carried serially through both volumes. The first 132 pages take up beam bridges and plate-girders, illustrating numerous types, and working out a number of more or less complete designs. The next 53 pages are devoted to viaducts and elevated railroads. Simple riveted trusses fill the next 70 pages, while the succeeding 35 pages treat simple pin trusses. Next come steel mill buildings, 50 pages; high office buildings, 93 pages; miscellaneous building work, including theatres, standpipes and elevated tanks, train sheds, etc., some 54 pages.

There are a number of points in the book which are open to criticism, a few of which follow: Considerable space is devoted to working out formulas for the cost of various structures, and these formulas are then used to determine the economic limits of various types of spans. The reviewer believes such formulas to be dangerous when used in any way except as the roughest sort of guide. The author applies these formulas to the determination of the economic panel length for a double-track plate-girder through span, obtaining 15 ft. He then states that for various reasons this result must be modified as the usual panel lengths for single-track bridges are from 12 to 14 ft., and for double-track bridges (all plate-girders) from 18 to 20 ft. A formula for economic panel lengths which varies 25% either way from practical design is hardly even a rough guide.

The counting of guard timbers on short spans as chords for wind bracing has the merit of novelty, at least. In discussing splices the author recommends two splice bars as the best practice for angle splices; and for web splices, cover plates as thick as the flange angles. The computation of pitch of vertical rivets in girder flanges is unnecessary. In the case of the connection of sidewalk brackets to girders or trusses, the reviewer does not believe it is correct to use the lowest rivet as a fulcrum about which to assume the other rivets in the connection to act, even if the bottom flange angle of the bracket is fitted to bear against the chord. After going through a lengthy derivation of a formula for economic panel lengths and depths, etc., the author says, in a footnote, that "in general it will be better to assume, in starting, values taken from a similar structure." In discussing pins, the author wastes considerable space in computing shears on pins. In the pin-packing plans which are shown the arrangement of bars is about as bad as it could be for moment on the pins.

In a book of this length, which attempts to explain the principles and practice of designing so many different kinds of structure and so many varieties of each kind, the treatment in most cases is necessarily hurried and superficial. The giving of a large number of detailed computations without adequate explanation makes it very difficult to follow the author's thought, and, in many cases, hard to understand by what path results are attained. The reader is apt to lose sight of the underlying principles in the effort to unravel the meaning of the figures.

The author's style is peculiar and uneven, and in some cases, ungrammatical. A lack of practical knowledge is sometimes shown. Taken as a whole, the book needs a complete revision. This would involve cutting out much of the unnecessary repetition of similar designs and adding thorough explanations of the principles and methods used.

Forestry for Beginners

ELEMENTS OF FORESTRY—By Frederick Franklin Moon, Professor of Forest Engineering, and Nelson Courtlandt Brown, Professor of Forest Utilization, New York State College of Forestry, Syracuse. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. xvii + 392; 65 illustrations. $2, net.

The remarkable growth of forestry in the United States within recent years warrants a new book dealing with the theory and practice of the subject. The book before us is a comprehensive review of forestry, well adapted to beginners and also to those who already have some knowledge of the art but have not had occasion to keep uptodate in this field.

As specific evidence of the growth of forestry in this country, it may be noted in passing that 31 of our states have forestry departments, 23 educational institutions give degrees and 42 schools give short courses in forestry; that the gross area of the National forests when this book was written was 186,000,000 acres, that indidivual states control 3,400,000 acres of forest lands, and that many cities have taken up forestry.

The first part of the present volume reviews the history of forestry in this and some foreign countries, takes up the individual tree, and then goes into the details of forest management, including improvement cuttings, planting, protection and mensuration. Lumbering, wood utilization, technology and preservation, forest economics and finance are next considered. The second part is on regional studies, or sectional surveys. Appendixes give original and present forest areas, uses of principal species, log rules and volume and yield tables and rates of growth. There is a glossary of 22 pages and a brief index. The book is well illustrated, chiefly with half-tones, and will doubtless be of practical value to many and of interest to many more.

POLYPHASE CURRENTS—By Alfred Still, Assoc. M. Inst. C. E., M. I. E. E., M. A. I. E. E., author of "Alternating Currents and the Theory of Transformers" and "Overhead Electric Power Transmission." Second edition, revised. New York: The Macmillan Co. London: Whittaker & Co. Cloth; 5x8 in.; pp. xii + 305; 101 illustrations. $1.50, net.

This edition is of unusual interest as the author has changed his residence from England to the United States. This, however, seems to have little significance so far as the revision is concerned for the book remains essentially a British text. One cannot expect much that is novel in a simple presentation of the principles of alternating currents. The merit of the book, both in the original

*Bridge and Signal Engineer, Massachusetts Public Service Commission, 1 Beacon St., Boston, Mass.

†Reviewed in "Eng. News," June 13, 1912.

and in the revised edition, lies in its clear style and logical arrangement of topics. The more general parts cover alternating currents broadly, polyphase currents more specifically, energy transmission by polyphase lines, induction motors and converters, etc. There is practically no description of actual machines as the text is particularly written for readers who have had workaday experience with such apparatus.

Aspects of the Panama Canal

THE PANAMA CANAL: Comprising Its History and Construction, and Its Relation to the Navy, International Law and Commerce—By Reuben E. Bakenhus, Corps of Civil Engineers, U. S. Navy, Public Works Officer, Navy Yard, Boston, formerly Assistant in Civil Engineering, Massachusetts Institute of Technology; Harry S. Knapp, Captain U. S. Navy, formerly Member of Naval War College Staff; and Emory R. Johnson, Professor of Transportation and Commerce, University of Pennsylvania, Member of Public Service Commission of Pennsylvania, Special Commissioner of Panama Canal Traffic and Tolls, 1911-1913. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. ix + 257; 20 illustrations and 6 folding drawings. $2.50, net.

The greatest difficulty in writing a book on the Panama Canal is to know what to leave out. While the engineer thinks of the Panama Canal primarily as a work of engineering, the statesman thinks of it as an achievement of diplomacy and of national defense, and the economist is interested in its effect upon the world's currents of trade.

The present book had its origin in a series of articles prepared at the request of the Board of Control of the U. S. Naval Institute. The three authors of the book have worked separately. Civil Engineer Bakenhus wrote substantially the first half of the book, covering the history of the canal and the features of design, construction and sanitation. Capt. Knapp contributed the chapters on "The Navy and the Panama Canal," and "The Panama Canal in International Law." Prof. Johnson wrote the concluding chapter, which discusses the commercial importance of the Canal.

It is a little remarkable that in a book on the greatest engineering work in the world, written by an engineer, the names of none of the engineers who have been responsible for the work are given. In fact, about the only names mentioned in the book, so far as we have found, after the period of French control ended, are those of Presidents Roosevelt and Taft. The names of Goethals or Stevens or Wallace do not occur in the book, save an acknowledgment to Goethals in the preface. Curiously enough, however, on one of the folder plates reproduced at the end of the book, a map and profile of the Pacific Division, there has been left the inscription: "Approved, S. B. Williamson, Division Engineer, June 24, 1910."

While the volume is a bulky one, the large type and heavy paper deceive one as to the amount of matter it contains. An estimate indicates that the number of words in the book is little greater than that in an average issue of ENGINEERING NEWS.

DEFINITIONS AND TABLES OF EQUIVALENTS OF WEIGHTS AND MEASURES—Bulletin No. 7, Kansas City Testing Laboratory, 1013 Grand Ave., Kansas City, Mo. Paper; 6x9 in.; pp. 16. 25c.

The author designed this bulletin to aid in spreading a working knowledge of the metric system and to show all ordinary relations and the one common relation of all units of measurement usually encountered in the different branches of applied science. In the research laboratory, and as an aid to students, the pressure and work conversion tables should be especially valuable.

Designing the Framework of Steel Buildings

REVIEWED BY R. FLEMING*

STEEL CONSTRUCTION: A Text and Reference Book Covering the Design of Steel Framework for Buildings—By Henry Jackson Burt, M. Am. Soc. C. E., Structural Engineer for Holabird & Roche, Architects. Chicago: American Technical Society, Drexel Ave. and 58th St. Flexible leather; 4x7 in.; pp. 372; 236 illustrations. $2.75.

The purpose of the book is thus stated by the author in the Introduction: "This book is intended to give its students the facts and formulas needed in designing the structural steel framework for buildings."

The book is divided into five parts. Part I, of 73 pages, is given to the method of steel manufacture, steel sections, specifications, unit-stresses, rivets and bolts. Part II, of 90 pages, is a clear and comprehensive treatment of beams and riveted girders. Part III, of nearly 100 pages, treats of compression members, tension members and wind bracing. Part IV consists of the design of the 16-story Fort Dearborn Hotel in Chicago, given in detail, with diagrams and calculations. Part V is devoted to the protection of steel, closing with a few pages on specifications.

The book is written by an engineer of experience, primarily for the benefit of young engineers. As roof trusses and mill buildings are excluded, it is practically limited to store, hotel and office buildings. A knowledge of mechanics, stresses and strength of materials is presupposed, although considerable theory is given.

Scattered throughout the book are many bits of information seldom found in textbooks, such as paragraphs on mill and stock orders, variation in weight, and column splices. Valuable suggestions on design are given in such paragraphs as those on investigation of riveted joints, thickness of web, choice of scheme, and cast-iron pedestals. The experienced designer will find but few paragraphs with which he is not in thorough accord.

An interesting portion of the book is the 30 pages on wind bracing. For the many-storied building where diagonals are not permissible the author uses, in the calculation of stresses and moments, what may be called the portal method. It is assumed that the horizontal shear on any plane due to wind pressure is equally distributed among the bays cut by that plane. The girders between columns at each floor act as a series of independent portals, thus bringing on the outside column of a transverse bent one half the shear taken by an intermediate column. The points of contraflexure are taken at the middle points of girders and column-story heights. This method is simple in calculation and the stresses and moments obtained are ideal for the detailer. Although the reviewer used it in the design of an 18-story building erected in 1913, he prefers what may be called the cantilever method, believing this to more nearly meet the conditions of wind action. At the same time he agrees with the author that the method used is not of prime importance, provided adequate provision is made for the resulting stresses. Exception might also be taken to the author's considering the girders that resist wind stresses as restrained beams. Will the end connections be made sufficiently rigid to warrant this assumption? The author recognizes the importance of the end connections in his statement: "The bracing strength of the interior framing is

*American Bridge Co., 30 Church St., New York.

limited by the strength of the connections to the columns and not by the strength of the girder and joist sections."

The designer of steel buildings will make no mistake in adding this book to his library. A copy should be in every architects' office in which a steel framework is to be designed. The flexible red leather cover, gilt edges, and rounded corners give it an attractive appearance that is seldom excelled by the technical press.

Cast-Iron and Steel Pipes

REVIEWED BY ALLEN HAZEN*

SOME CONSIDERATIONS REGARDING CAST IRON AND STEEL PIPES—By John Sharp, M. I. Mech. E., author of "Modern Foundry Practice." New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. viii + 142; 21 illustrations. $1.50, net.

As the title implies, this book takes up the matter of cast-iron and steel pipes in a somewhat fragmentary way and not with the idea of making a complete treatise.

The growing importance of mild steel as a material for pipes is recognized. The matter is considered especially from a laboratory and physical standpoint; the impurities in the metal and their effects upon physical properties are considered. Many interesting formulas are given but these are often theoretical and of limited application. For instance, the formulas for the external pressures that can be sustained relate to uniform pressures and loading; and there is no discussion of the much more important subject of unequal loading in the trenches. The methods of joining steel pipes that are described would hardly be accepted as representing the best American practice. The corrosion of steel and cast iron, both internal and external, are discussed and their effects upon the carrying capacity of pipes and upon their durability under various conditions. The methods proposed by an English Board of Engineers for protecting the Coolgardie pipe line in Australia from the effects of corrosion are given at length in the last chapter.

The book has considerable suggestive value to those who have followed its subject matter but is not in itself to be taken as a sufficient guide.

THE PROBLEM OF GREATER NEW YORK AND ITS SOLUTION—By Harry Chase Brearley. With a Supplementary Chapter by Dr. Elmer L. Corthell. Published under the Auspices of the Committee on Industrial Advancement of the Brooklyn League, 50 Court St., Brooklyn, N. Y. Leatherette; 6x9 in.; pp. 132; maps, diagrams, illustrations, and appendix of valuable civic data, and an analytical index. 50c.

The author of this book has written it to prove that New York's further commercial growth is hampered by its lack of adequate harbor facilities and that the best way to eliminate these difficulties and provide for the city's further development on a broad scale is to proceed with the improvement and building up of a great new harbor at Jamaica Bay, work on which in fact has already begun.

The main contention of the author is that the development of Jamaica Bay is not proceeding at a rapid enough pace, and his book is chiefly devoted to showing the great commercial, social and economic benefits which would result from immediately proceeding with the development of commerce at this point on a large scale.

Without attempting to dispute the author's reasoning, it is doubtful whether he appreciates the difficulties that exist in changing the channels of commerce. It still remains to be demonstrated to what extent ocean shipping will be satisfied with a location on Jamaica Bay. Sometimes these large schemes for building up great commercial centers in the outskirts of a city prove dismal failures because commerce does not seek the place which has been provided for it. The author unnecessarily narrows his viewpoint by considering only that part of the port of New York lying within New York State, and considering the New Jersey portion of the port as a commercial rival. This may make easier his demonstration of the importance of Jamaica Bay, but does not tend to make his conclusions more reliable.

Sewage-Works Operation

THE OPERATION OF SEWAGE DISPOSAL PLANTS: A Manual for the Practical Management of Sewage Disposal Works, with Suggestions as to Improvements in Design and Construction—By Francis E. Daniels, Director of Water and Sewerage Inspection, Board of Health of the State of New Jersey. New York: Municipal Journal, 50 Union Square. Cloth; 5x8 in.; pp. 136; illustrated. $1.50.

Author and publisher alike have rendered a distinct service in the production of this little book. The volume contains many useful hints on the operation of sewage-works, and some valuable suggestions on design, based chiefly on the day-by-day experience of the author in attempting to improve the working conditions of sewage-treatment plants in New Jersey—of which there are now about one hundred and thirty.

Grit chambers, screens, sedimentation, septic and Imboff tanks, sludge beds, contact beds, sprinkling filters, sand filters, broad and subsurface irrigation, chemical precipitation, electrolytic treatment, trade wastes, testing stations, physical, chemical and bacterial tests, and plant-operation records are taken up in succession.

Many of the points made are driven home by the recital of telling incidents drawn from the author's observations in New Jersey. Were there more large plants in the state for the author to draw from the value of the book would perhaps be somewhat greater, but few will enter serious complaint against a book which deals chiefly with small plants, especially when the number and variety are so large as in this case. Had the author felt free to mention the names of plants, both in the text and in the titles to cuts, the interest of the book would have been increased, but this is a minor matter. The cloudiness of most of the half-tone views, from photographs by the author, must be a disappointment to all concerned, but as a rule this does not detract from the practical value of a volume unique among publications on sewage treatment.

A brief pamphlet report on "Toilet Regulations for Industrial Establishments" has been published by the Boston Society of Civil Engineers (Tremont Temple, Boston, Mass.). The Massachusetts State Board of Labor and Industry requested the Society to assist the Board in the preparation of rules for the regulation of water-closet and washing facilities in Massachusetts' industrial establishments. The request was referred to the Sanitary Section of the Society for action, and a committee composed of R. S. Weston, G. A. Carpenter and R. A. Hale was appointed to deal with the request. The committee conferred with the sanitary engineer of the Board, visited industrial establishments, looked up the regulations of other states and consulted the literature on the subject and interviewed engineers having knowledge of this branch of sanitation. Finally, the committee revised a

*Hazen, Whipple & Fuller Consulting Civil Engineers, 30 E. 42d St., New York.

draft of regulations which had been submitted to it by the Board. The revised draft is printed in the pamphlet already mentioned.

Masonry Dam Construction

CONSTRUCTION OF MASONRY DAMS—By Chester W. Smith, Consulting Engineer. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xi + 279; 68 illustrations. $3, net.

While there are several good books on the theory of dam design, the field of masonry dam construction has not been hitherto touched except in periodical literature. During the past decade many large masonry dams have been built, and the experience gained in their construction can now be utilized. This is practically what Mr. Smith has done; his excellent book is in effect a collation of the lessons learned on the large masonry dams of the Reclamation Service and of recent hydro-electric and water-supply projects.

The volume is virtually divided into two parts: the first on construction details, the second on cost details. The construction section can be used as a textbook for guidance on actual dam building; the cost data are intended for the estimator.

Early chapters are devoted to exploration of the site (in which special attention is paid to boring machines and well drills); diversion methods and works; foundation difficulties, including excavation and grouting; and the intimate details of masonry construction, such as pointing, stone cutting and setting, the making and laying of concrete blocks and the rarely explained technique of quarry practice.

A few intermediate chapters take up general subjects of interest to dam builders, such as the freezing of concrete, the effect of underpressure on dams (mostly derived from actual experience and experiment), and the questions of drainage expansion and ice pressure with means whereby they are cared for in construction. The final chapters go into the most intimate detail of cost, with specific figures from certain typical dams. There are also chapters on possible future methods of construction, as conceived by the author, and a list of the large dams of the world with some statistical data.

In spite of its usual enormous mass, the masonry dam is one of the most delicate of engineering structures, in which the opportunities for operative trouble are infinite and the possibilities of failure fairly high. In no other structure, perhaps, does the design play so minor a part or is so much of success or failure dependent upon decisions made after construction has commenced. For these reasons a text on construction is welcome and when it is so well done as is Mr. Smith's treatise it is doubly welcome.

Pamphlets on "Electric Wire and Cable Terminology" and "Insulating Properties of Solid Dielectrics" have been issued by the U. S. Bureau of Standards, Washington, D. C.

A monthly devoted to "safety, efficiency and conservation" in mining appeared for the first time in January, 1915, with the title, "The Mining Congress Journal" (Munsey Bldg., Washington, D. C.).

The highest and lowest meter rates of 709 waterworks in the United States and Canada, and also some "model meter regulations," are given in a pamphlet just issued by the Buffalo Meter Co., 290 Terrace, Buffalo, N. Y.

The Utah Society of Engineers (Salt Lake City) is one of several which have recently withdrawn from the Association of Engineering Societies and begun the publication of local journals. This first issue of the Utah Society's "Journal" (January, 1915) is a creditable piece of work.

Employers of labor in New York State, and to a lesser extent elsewhere, may be interested in two bulletins, recently published by the New York Department of Labor (Albany, N. Y.): No. 64, "Changes in Union Wages and Hours in 1913," and No. 65, "Union Rates of Wages and Hours in 1913."

There have been published by the Geological Survey, Washington, D. C., extracts from "Mineral Resources of the United States, Calendar Year 1913," as follows: Coal, Petroleum, Natural Gas, Asphalts, Coke, Stone, Lime, Lead, Copper, Gold and Silver, Metals and Metallic Ores; the last two for 1912 as well as 1913.

A brief illustrated account of "Recent Storm Effects on the Northern New Jersey Shoreline, and Their Supposed Relation to Coastal Subsidence," by Douglas W. Johnson and Warren S. Smith, is appended to Bulletin 12, "Annual Administrative Report of the State Geologist of New Jersey (Trenton, N. J.) for the Year 1913."

The "New York Health Almanac" for 1915 (State Department of Health, Albany, N. Y.) gives, opposite each calendar, health and sanitary hints for the month. Thus, for August there are some remarks on typhoid fever. The "Anniversaries" for each day of the month relate to persons or events of public-health interest, so far as feasible.

An interesting report on the "Pollution of Streams" in Connecticut has just been published by the State Board of Health (Hartford, Conn.). It contains sketch maps of the various streams and their tributaries, half-tone views, and tables and diagrams giving the results of dissolved oxygen and B. coli analyses of samples. The investigation was conducted by a committee of which J. Frederick Jackson, Engineer-Member of the Board, was Chairman. Mr. Jackson supervised the work and was assisted by R. C. Meeker. The report is signed by all the members of the Board.

Sanitary engineers will find "Public Health Reports" (free on application to the U. S. Public Health Service, Washington, D. C.) of increased value since the practice was begun of printing in each weekly number a paper by one of the sanitary engineers or chemists connected with the Service. Recent numbers have contained several articles on storage reservoirs in relation to malaria.

The issue of Feb. 26 contains an illustrated article on portable plants for the hypochlorite treatment of water-supplies, by H. A. Whittaker, of the staff of the Minnesota State Board of Health.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale, and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ADVANCED THEORY OF ELECTRICITY AND MAGNETISM: A Text-Book for Colleges and Technical Schools—By William S. Franklin and Barry MacNutt. New York: The Macmillian Co. London: Macmillan & Co., Ltd. Cloth; 6x9 in.; pp. vii + 300; 217 illustrations. $2, net.

THE AMERICAN YEAR BOOK: A Record of Events and Progress (1914)—Edited by Francis G. Wickware, With Coöperation of a Supervisory Board Representing National Learned Societies. New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. xviii + 862. $3.50.

THE ART OF ESTIMATING THE COST OF WORK, With Specific Reference to Unstandardized Operations as in Jobbing Shops or Repair Work—By William B. Ferguson, Naval Constructor, U. S. N. New York: The Engineering Magazine Co. Cloth; 5x8 in.; pp. 97; illustrated. $1.

THE ART OF LANDSCAPE ARCHITECTURE; Its Development and Its Application to Modern Landscape Gardening—By Samuel Parsons, author of "Landscape Gardening." New York and London: G. P. Putnam's Sons. Cloth; 6x9 in.; pp. xxi + 347; 57 illustrations. $3.50, net.

DIE CHEMIE DER HYDRAULISCHEN BINDEMITTEL; Wesen und Herstellung der Hydraulischen Bindemittel—Von Dr. Hans Kühl, Inhaber, und Dr. Walter Knothe, 1. Assistent, des Zement-und Mörteltechnischen Laboratoriums Dr. Wilhelm Michaëlis, Berlin-Lichterfelde. Leipzig: S. Hirzel. Paper; 7x10; pp. xvi + 347; 51 illustrations. 14 Marks.

CIVIL ENGINEERING SPECIFICATIONS AND CONTRACTS—Prepared by Richard I. D. Ashbridge, M. Am. Soc. C. E. Chicago: American Technical Society. Cloth; 5x8 in.; pp. 186; illustrated. $1.

CONCRETE STONE MANUFACTURE—By Harvey Whipple, Managing Editor, "Concrete-Cement Age." Detroit, Mich.: Concrete-Cement Age Publishing Co. Flexible leather; 4x7 in.; pp. 255; 126 illustrations. $1, postpaid.

DESCRIPTIVE GEOMETRY FOR STUDENTS IN ENGINEERING SCIENCE AND ARCHITECTURE: A Carefully Graded Course of Instruction—By Henry F. Armstrong, Associate Professor of Descriptive Geometry and Drawing, McGill University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 7x10 in.; pp. vi + 125; 114 illustrations. $2, net.

DESIGN IN LANDSCAPE GARDENING—By Ralph Rodney Root, Assistant Professor of Landscape Gardening, in charge of Professional Courses, University of Illinois, and Charles Fabens Kelley, Assistant Professor of Art, Head of Department of Art, Ohio State University. New York: The Century Co. Cloth; 6x9 in.; pp. 278; 65 illustrations. $2, postpaid.

THE DESIGN OF STEAM BOILERS AND PRESSURE VESSELS—By George B. Haven, Professor of Machine Design, and George W. Swett, Assistant Professor of Machine Design, Massachusetts Institute of Technology. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. vii + 416; 197 illustrations. $2.50, net.

ENGINEERING OFFICE SYSTEMS AND METHODS; Together with Schedules and Instructions for the Collection of Preliminary Data for Engineering Projects; Sampling, Inspecting and Testing Engineering Materials; Conducting Domestic and Export Shipping Operations; etc.—By John P. Davies, Assoc. M. Am. Soc. C. E. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xvi + 544; 243 illustrations. $5, net.

FIELD PRACTICE: An Inspection Manual for Property Owners, Fire Departments and Inspection Offices, Covering Common Fire Hazards and Their Safeguarding and Fire Protection and Upkeep, 1914 Edition—Published by National Fire Protection Association, 87 Milk St., Boston, Mass. Flexible leather; 4x7 in.; pp. 199. $1.50.

HANDBOOK OF MACHINE SHOP MANAGEMENT—By John H. Van Deventer, M. Am. Soc. M. E., Associate Editor "American Machinist." New York and London: McGraw-Hill Book Co., Inc. Flexible leather; 4x7 in.; pp. viii + 374; 244 illustrations. $5, net.

HAND FIRING SOFT COAL UNDER POWER-PLANT BOILERS—By Henry Kreisinger. Washington, D. C.: U. S. Bureau of Mines. Technical Paper 80. Paper; 6x9 in.; pp. 83; illustrated.

HEATING AND VENTILATING BUILDINGS: A Manual for Heating Engineers and Architects—By Rolla C. Carpenter, M. Am. Soc. M. E., Professor of Experimental Engineering, Cornell University. Sixth edition, revised and rewritten. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xiv + 598; 290 illustrations. $3.50, net.

LAND DRAINAGE: A Treatise on the Design and Construction of Open and Closed Drains—J. L. Parsons. Chicago: The Myron C. Clark Publishing Co. London: E. & F. N. Spon, Ltd. Cloth; 6x9 in.; pp. xi + 165; 32 illustrations. $1.50.

LUBRICATION OF THE MOTOR CAR CHASSIS; Instructions for Systematic Oiling of All Important Parts of the Automobile Mechanism—A Chart Prepared by Victor W. Page, author of "The Modern Gasoline Automobile." New York: The Norman W. Henley Publishing Co. 25c.

MASONRY: A Short Text-Book on Masonry Construction, Including Descriptions of the Materials Used, their Preparation and Arrangement in Structures—By Malverd A. Howe, M. Am. Soc. C. E., Professor of Civil Engineering, Rose Polytechnic Institute. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. ix + 160; 115 illustrations. $2, net.

THE "MECHANICAL WORLD" ELECTRICAL POCKET BOOK For 1915: A Collection of Electrical Engineering Notes, Rules, Tables and Data. Manchester and London: Emmott & Co., Ltd. Baltimore, Md.: The Norman, Remington Co. Cloth; 4x6 in.; pp. 303; 130 illustrations. 50c., postpaid.

THE "MECHANICAL WORLD" POCKET DIARY AND YEAR BOOK For 1915: A Collection of Useful Engineering Notes, Rules, Tables and Data. Manchester and London: Emmott & Co., Ltd. Baltimore, Md.: The Norman, Remington Co. Cloth; 4x6 in.; pp. 439; 87 illustrations. 50c., postpaid.

MEN OF SCIENCE AND INDUSTRY: A Guide to the Biographies of Scientists, Engineers, Inventors and Physicians—Pittsburgh, Penn.: Carnegie Library. Paper; 6x9 in.; pp. 189. 30c., postpaid.

MINING COSTS OF THE WORLD: A Compilation of Cost and Other Important Data on the World's Principal Mines—By Edmond Norton Skinner and H. Robinson Plate. New York and London: McGraw-Hill Book Co., Inc. Flexible leather; 5x8 in.; pp. viii + 406; maps. $5, net.

NEW YORK STATE PUBLIC SERVICE COMMISSION FOR THE FIRST DISTRICT—Annual Report for 1913. Vol. I. Report and Appendices A to G, inclusive. New York City: The Commission, 154 Nassau St. Cloth; 6x9 in.; pp. 1200; illustrated.

NEW YORK STATE PUBLIC SERVICE COMMISSION FOR THE SECOND DISTRICT—Annual Report for 1913. Albany, N. Y.: The Commission. Cloth. Vol. 1; 6x9 in.; pp. 1147. Vol. II, Abstracts of Reports of Corporations, Steam Railroad, Electric Railroad, Express, Sleeping Car, Inspection of Railroads; 9x12 in.; pp. 415. Accompanied by two large folding maps.

OXY-ACETYLENE WELDING AND CUTTING, Including the Operation and Care of Acetylene Generating Plants and the Oxygen Process for Removal of Carbon—By Calvin F. Swingle, author of "The Twentieth Century Handbook for Steam Engineers and Electricians," etc., etc. Chicago: Frederick J. Drake & Co. Cloth; 4x7 in.; pp. 190; 76 illustrations. $1. Leather, $1.50.

PLAIN AND REINFORCED CONCRETE ARCHES—By J. Melan (Kaiserlicher-Königlicher Hofrat), Professor of Bridge Design of the German Technical School at Prague. Authorized translation by D. B. Steinman, Professor of Civil Engineering, University of Idaho. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. x + 161; 43 illustrations. $2, net.

PRACTICAL IRRIGATION AND PUMPING; Water Requirements, Methods of Irrigation and Analyses of Cost and Profit—By Burton P. Fleming, Assoc. M. Am. Soc. C. E., Head of Department of Mechanical Engineering, State University of Iowa; formerly Irrigation Engineer, Office of Irrigation Investigations, U. S. Department of Agriculture. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. xvi + 226; 62 illustrations and diagrams. $2, net.

PRACTICAL TALKS ON FARM ENGINEERING; A Simple Explanation of Many Everyday Problems in Farm Engineering and Farm Mechanics Written in a Readable Style for the Practical Engineer—By R. P. Clarkson, Professor of Engineering, Arcadia University, Nova Scotia; Consulting Engineer; Engineering Correspondent of the "Rural New-Yorker." Garden City, N. Y., and New York City: Doubleday, Page & Co. Cloth; 4x8 in.; pp. xv + 223; 43 illustrations. $1, net.

PREVENTING LOSSES IN FACTORY POWER PLANTS—By David Moffat Myers. New York: The Engineering Magazine Co. (Works Management Library.) Cloth; 5x8 in.; pp. xvi + 560; 68 illustrations. $3.

SANITARY REFRIGERATION AND ICE-MAKING—By J. J. Cosgrove, author of "Principles and Practice of Plumbing"; "Sewage Purification and Disposal"; "History of Sanitation"; "Wrought Pipe Drainage Systems"; "Plumbing Plans and Specifications"; "Plumbing Estimates and Contracts; "Design of the Turkish Bath"; "Rock Excavating and Blasting." Philadelphia, Penn.: Technical Book Publishing Co., 215 W. Pomona St., Germantown. Cloth; 6x9 in.; pp. 331; 103 illustrations. $3.50.

A SCHOOL ELECTRICITY—By C. J. L. Wagstaff, Headmaster of the Haberdashers' Hampstead School. Cambridge, England: The University Press. New York: G. P. Putnam's Sons. Cloth; 6x9 in.; pp. xi + 250; 136 illustrations. $1.25, net.

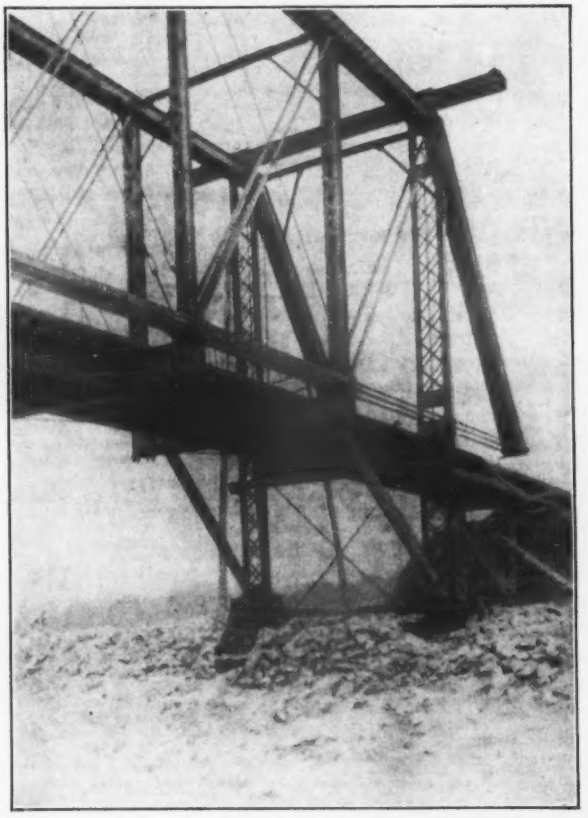
SEWAGE PURIFICATION AND DISPOSAL—By G. Bertram Kershaw, M. Am. Soc. C. E., Engineer to the Royal Commission on Sewage Disposal. New York: G. P. Putnam's Sons. Cambridge, England: The University Press. (Cambridge Public Health Series.) Cloth; 6x9 in.; pp. x + 340; 56 illustrations. $3.75.

VALVE GEARS—By Charles H. Fessenden, Assistant Professor of Mechanical Engineering, University of Michigan. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. viii + 170; 171 illustrations. $2, net.

Field and Office

Supporting a Bridge While Rebuilding the Abutments

A rather unusual method of supporting a bridge to maintain traffic over it during reconstruction of the abutments was adopted by the Rochester & Eastern R.R. at the crossing of the State barge canal at Bushnells Basin near Rochester, N. Y. The bridge has a span of about 150 ft. and is a pin-connected through Pratt-truss bridge. The old abutments were founded at shallow depth below the surface; on account of the construction of the



TEMPORARY SUPPORT OF ROCHESTER & EASTERN R.R. BRIDGE OVER BARGE CANAL AT BUSHNELL'S BASIN

new canal prism it was desired to lower them to the grade of the new prism and also to support them on piles.

The canal work made it impossible to construct a diversion trestle around the bridge, but traffic had to be maintained over the bridge itself. The company's engineer decided to support the bridge by placing steel columns at the hips or ends of the upper chord, thus taking the load off the abutments and making their reconstruction possible.

The photograph herewith shows the north end of the structure as supported in this way. The end panel of floor and the track in the space beyond were carried by I-beams resting on wooden bents. The method proved perfectly successful in carrying out the intended purpose. The excavation was made, the piles driven, and the concrete placed without interference to traffic, except for a slow order.—CHARLES R. WATERS, Fort Plain, N. Y.

Features of a Large Winter Concreting Job

A new penal institution, the House of Correction, is being built for Milwaukee County on the county farm, about two miles north of North Milwaukee, Wis. The architects are Leenhouts & Guthrie, Milwaukee. The group comprises 14 buildings, all of which are of reinforced concrete (walls, floor and roof), except a frame residence for the inspector. In September, 1914, contracts for the complete work were awarded to the Coddington Engineering Co., of North Milwaukee, Wis., at $235,000. The time limit is 16 months, but the rate of progress has been so satisfactory that the contractor expects to finish in ten months. The work is under the per-

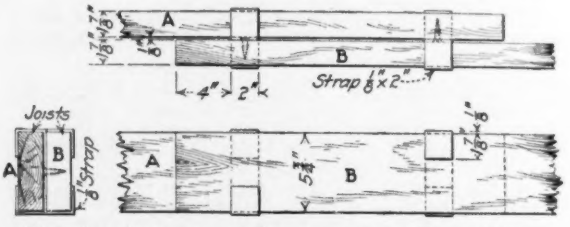


FIG. 1. ADJUSTABLE CONNECTION OF FORM JOISTS

sonal direction of S. C. Coddington, president of the company. The engineer representing the county is Alfred C. Taddey.

FORMS AND TOWERS

The forms for walls and floor slabs are of 1-in. matched and dressed lumber and are fabricated in the carpenter shop on the site. They are made in panel units 30 in. wide, and in lengths of 8, 10 and 12 ft. Before leaving the shop they are dipped into a vat containing heated paraffin oil, and after being drained are ready for use. These panels permit of economical erecting and stripping and with reasonable care they may be used at least eight times. All details for beam, girder and column forms are made in the office, and after the sides and bottoms have been built up in the mill they are marked to facilitate assembling in the field.

Adjustable joists are used, instead of cutting 2x6-in. lumber to fit the various panel lengths. This construction is shown in Fig. 1. An iron strap ⅛x2 in. is bent to Z-shape and is attached about 4 in. from the end of a 2x6-in. timber, 6 ft. or more in length, by means of a No. 12 screw. When it is desired to put the joist in position, two such pieces are fitted together, as shown, and are slid longitudinally in the straps until they fit the span. This construction saves much measuring and

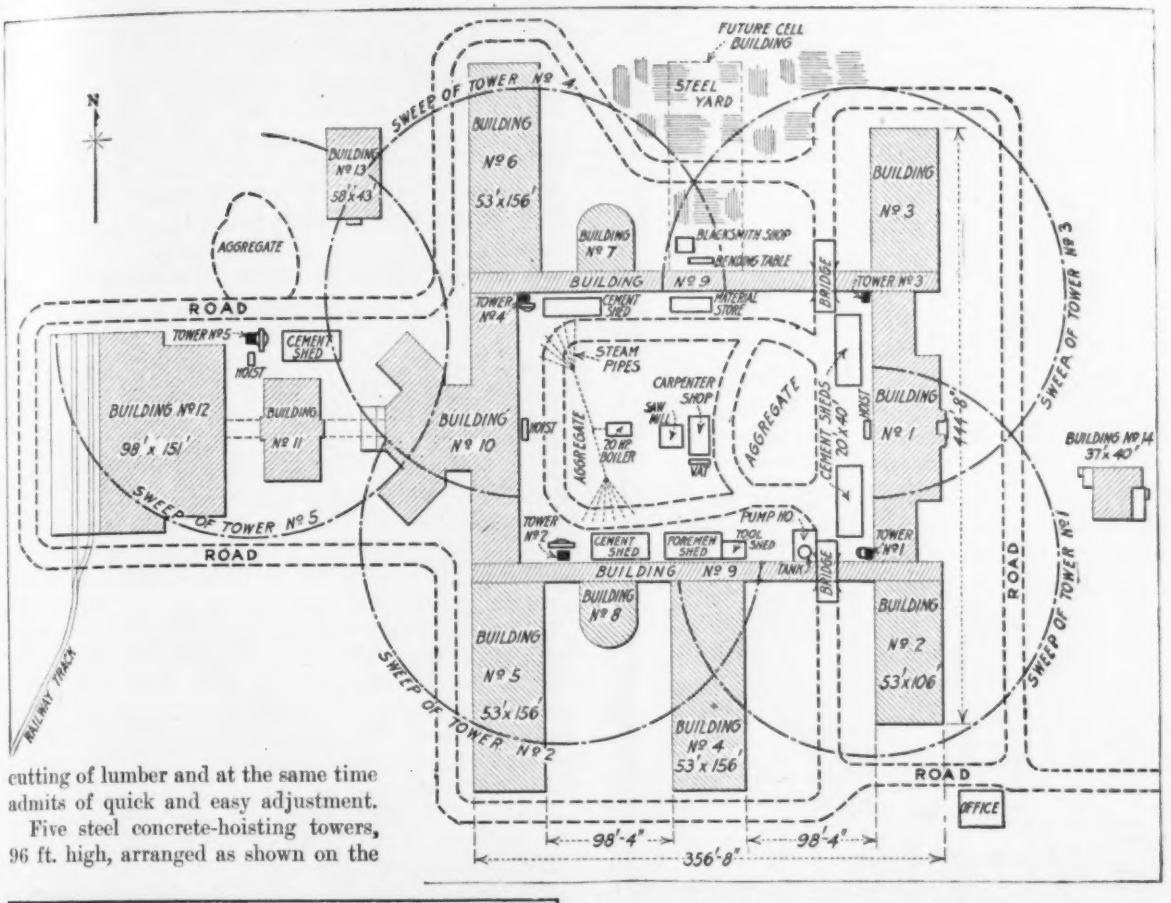


FIG. 2. LAYOUT OF PLANT FOR CONSTRUCTION OF NEW HOUSE OF CORRECTION, NORTH MILWAUKEE, WIS.

cutting of lumber and at the same time admits of quick and easy adjustment.

Five steel concrete-hoisting towers, 96 ft. high, arranged as shown on the plan, Fig. 2, are used to distribute the concrete to all the buildings. They are of the Lakeside sectional or knock-down type (Fig. 4), with independent and interchangeable members put together with bolts.

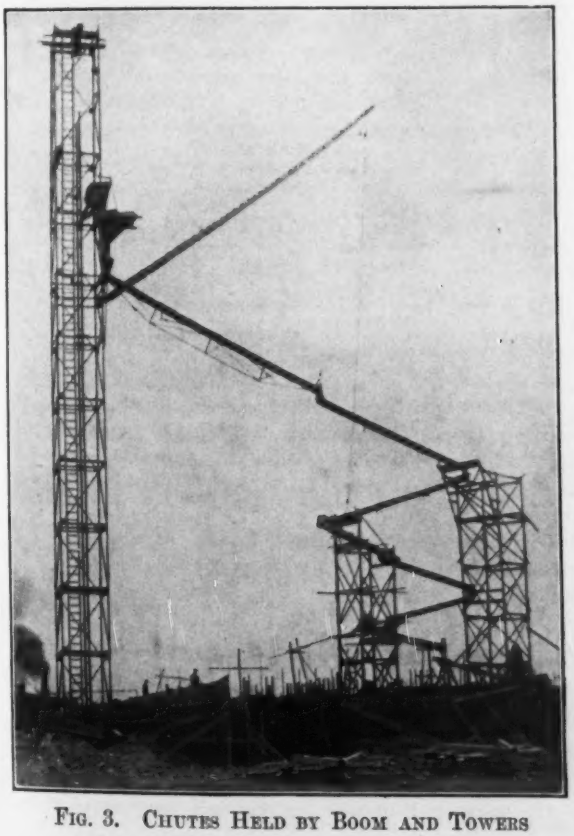


FIG. 3. CHUTES HELD BY BOOM AND TOWERS

The towers are 6½ ft. square, and are designed to carry at any corner a boom for the support of the first sections of the spout or chute. They are composed entirely of steel angles, and are so designed that all diagonals are interchangeable, as also are the horizontal struts and post sections. Thus there are only three kinds of members employed, which greatly facilitates the erection. All bolted connections are easily accessible. The corner posts have holes punched so that the boom seats and loading hopper can be placed at any panel point on any side of the tower. The horizontal struts are also punched to accommodate the hoist guides at any gage and facing in any direction, for maximum flexibility in adaptation.

For supporting the chute, a 60-ft. telegraph pole is used as a boom instead of a steel boom, the former being lighter and thus allowing the boom a greater horizontal reach. Fig. 3 shows the boom and two sections of the chute extending from the elevator to an auxiliary tower and several lengths of chute extending thence on tower supports to the place where the concrete is deposited. Of the chute sections suspended from the boom one is 50 ft. long and the other 40 ft. The longer chute has one end supported at the tower and the other end by an adjustable line from the end of the boom. These towers and chutes

were built by the Lakeside Bridge & Steel Co., of North Milwaukee, Wis.

A distinctive feature of this construction is that the two highest sections of the chute (forming the entire line from the main tower to the auxiliary tower) are handled quickly and easily by the simple operation of swinging the boom into the desired position, and as the boom is attached to a corner of the tower, it may be swung through an arc of 270°.

The chutes that lead from the auxiliary tower to the forms are made in sections 30 ft. in length and less. They are supported by temporary A-frames, and as they are fitted with swivel joints they are easily swung in any direction. Each tower will be used to place approximately 4000 cu.yd. of concrete, and has a ½-yd. mixer set in a pit at the base.

Concreting in Winter

As this work is being carried on during the winter, arrangements have been made to heat the materials. A large number of 1¼-in. galvanized-iron pipes of different

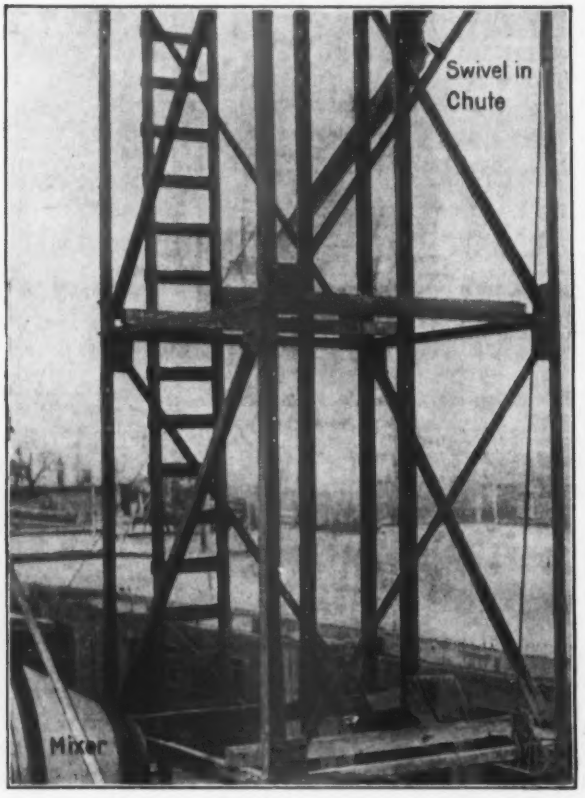


Fig. 3. Near View of Knockdown Hoist-Tower

lengths, with open T-connections at each 12-ft. joint, extend in fan shape from a central point and are connected up with a steam hose to a portable 20-hp. boiler (Fig. 2). These are laid on the ground and the gravel is dumped upon them. When it is desired to use the material, steam is turned on and runways are laid on the pile between the pipes, so that the hottest material is always handled first.

The water for mixing purposes is furnished by the county, and is pumped from a well about 2000 ft. from the job into an elevated tank. To this tank is attached a feed-water pump with a live-steam connection in the discharge line, and by this device the water is sent to the mixers under pressure and at a temperature of about 120°. Calcium chloride is added to each batch. After the concrete has been deposited, sheets of canvas with a generous topping of straw and manure protect it from freezing, and in the case of floor slabs additional protection is afforded by the use of salamanders.

Coal Slack for Concrete Aggregate

By R. B. Ketchum*

Owing to the scarcity of sand and gravel in the vicinity of mines in the coal fields of Utah, it has been deemed advisable in a number of instances to make concrete with coal slack aggregate. Bulkheads in some mines have been built of this material and its use has been brought to our attention to such an extent that we have conducted a series of experiments to determine something as to the properties of such concrete. The tests were made under the direction of the writer by Robert Flagel, a recent graduate of the University of Utah.

A few preliminary experiments were made on concrete made of lignite coal from Rock Springs, Wyo., but it was found impossible to do anything with coal of this character, on account of the great change of volume of the coal in contact with moisture. Hence, the experiments were all made with hard bituminous coal from Clear Creek and from Castle Gate, Utah.

A sieve analysis of the coal slack was made, and the different sizes of materials placed in separate sacks. In mixing, the aggregate was graded approximately according to the ideal gradation of sizes given in Fuller's curve, with a maximum size of one inch. The test made on 6-in. cubes of varying proportions (shown both by weight and volume) are given in the accompanying table. A standard portland cement was used.

COMPRESSION TESTS ON CONCRETE WITH COAL SLACK AS AGGREGATE
(Each Figure is Average of Three Tests)

Proportion				Clear Creek Coal		Castle Gate Coal	
By Vol.	By Wt.	Age Days	Storage	Weight, Lb. per Cu.Ft.	Break. Load, Lb. per Sq.In.	Weight, Lb. per Cu.Ft.	Break. Load, Lb. per Sq.In.
1:5	1:3	30	Water	88.25	725	94.00	785
		30	Air	82.40	780	81.28	710
		90	Water	93.28	1330	94.80	1610
1:10	1:6	30	Water	82.48	228	86.0	275
		30	Air	72.60	216	72.0	248
		90	Water	85.28	550	85.28	727
1:15	1:9	30	Water	80.00	143	82.0	155
		30	Air	73.00	143	71.3	126
		90	Water	80.65	362	80.64	315

Comparison of these tests with similar ones on gravel concrete show that the coal-slack concrete is about 50% as strong as gravel concrete at the age of 90 days, with a rich mixture of 1:5, and about 25% as strong as gravel concrete with a lean mixture of 1:15, the weight of the 1:5 coal concrete being about 60% that of the gravel concrete. It is to be noted especially that the coal concrete makes a very great gain in strength with age.

A New Revolving Steam-Shovel

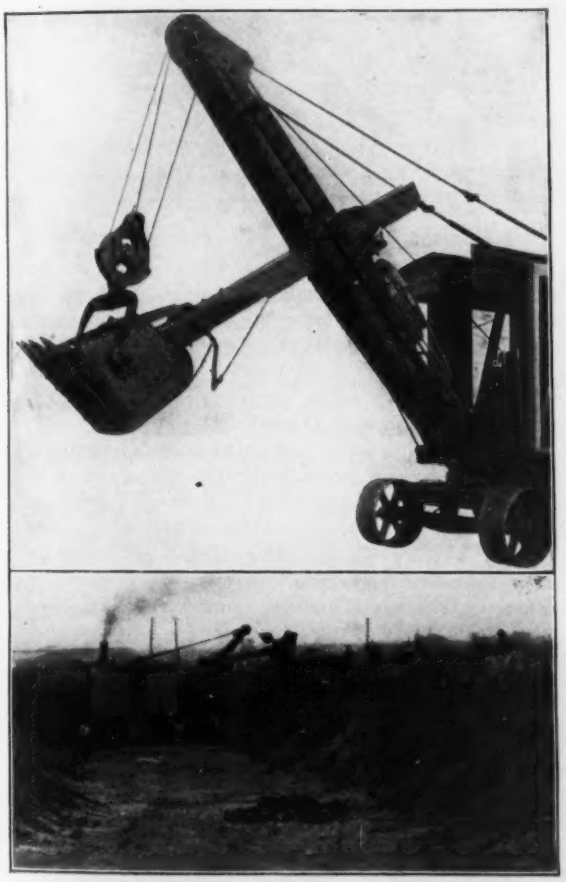
A ¾-yd. steam shovel built along the standard lines of the revolving type but having certain unusual features is now being manufactured by the Ball Engine Co., Erie, Penn., for light contracting work. The most strik-

*Professor of Surveying and Railroad Engineering, University of Utah, Salt Lake City, Utah.

ing feature is an automatic crowding device, by means of which, if the automatic-control latch lever has been set in the proper notch, the crowding engine works in such relation to the hoisting motion as to cut a level floor without further manipulation. This relieves the operator of the necessity of constantly playing one engine against the other.

The automatic device is fitted to the ordinary crowding mechanism, in which power is applied by a pair of direct-connected reversing engines rotating a shipper shaft which carries a gear engaging a rack on the dipper handle. When the engines operate they move the dipper handle out or in. The automatic control works as follows: A small pinion on one end of the shipper shaft operates a small auxiliary rack which travels in or out as the dipper handle moves in or out. On the end of this auxiliary rack is a small roller traveling on a miniature track, representing the floor bottom to be cut, which is connected to the control valves of the crowding engines and to the operator's crowding-lever as well, by a simple system of levers which governs the relative movement of the hoisting and crowding engines.

To cut a level floor the automatic-crowding latch-lever is dropped into the proper notch on the quadrant, which



"Erie" Steam Shovel for Digging Level Floors

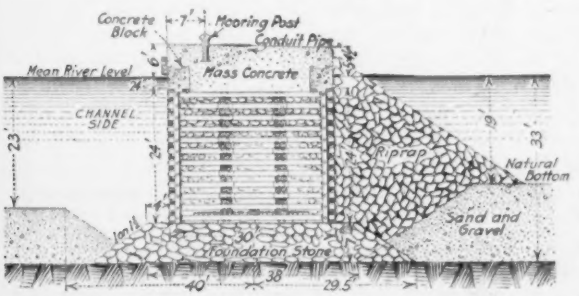
corresponds to this grade. This operation sets the roller track in a certain position. Now by starting the hoisting and crowding engines the dipper will crowd out along a level line. Placing the automatic lever in the second notch results in a cut slightly down-grade; in the third notch the dipper teeth cut farther below grade. When the latch lever is in the notch nearest to the operator, the automatic device is not in action and the crowding motion becomes the same as on any shovel equipped with a standard shipper shaft and crowding engine.

The manufacturer claims that cuts of 12 in. in depth can be excavated at the rate of 25 to 35 cu.yd. per working hour. The shovel can be used for giving roads an even crown.

The "Erie" shovel is operated by three hand-levers and a foot-brake. One lever controls the crowding engines and another the swinging engines. The weight of the shovel is 41,000 lb. The boom is 17½ ft. long and 17 ft. 11 in. high in working position. The maximum width of cut at floor level is 35 ft. The machine is designed so that either traction or standard-gage car wheels are interchangeable in the same truck frame. It can also be equipped with a special boom or auxiliary apparatus for adapting the machine for locomotive-crane service, or for clamshell, orangepeel or dragline work. It is claimed that the machine will handle a 32-ft. locomotive-crane type of boom and a ½-cu.yd. grab bucket.

A Crib-and-Concrete Guide Pier at the Black Rock Ship Lock

A strong cross-current of the Niagara River at Black Rock, N. Y., on Lake Erie, made entrance to the Black Rock ship lock so difficult that the United States Government deemed it advisable to construct a large guide pier to deflect this current away from the lock gates. The conditions were such that considerable study was required on the part of the engineers, and it was only after careful consideration that the present plans were adopted.



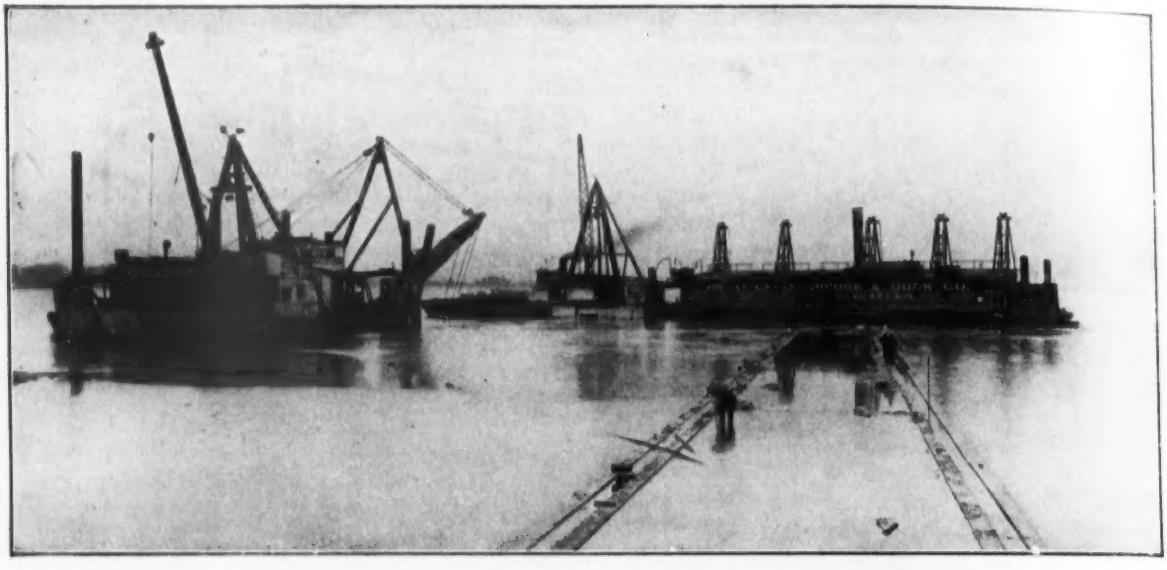
Cross-Section of Outer Portion of the Guide Pier at Black Rock, N. Y.

The pier will be 1050 ft. long, 400 ft. of it being 24 ft. wide, and the remainder 30 ft. wide.

The contract for the construction of this pier was awarded to the Great Lakes Dredge & Dock Co., on April 22, 1914, and was started by them immediately, and carried to a point during the summer that leaves only a portion of the concrete superstructure to be completed. It is anticipated that this will be finished by May 1, which is in ample time for the needs of navigation on the Great Lakes the coming year.

The pier constructed is timber cribwork filled with broken stone, with mass concrete on top. Concrete blocks of a richer mixture than the mass concrete are laid end to end on the perimeter of the cribwork, and their top

and inside surfaces covered with mass concrete, as shown in the drawing. In this particular case, these blocks, which weigh from 6 to 12 tons each, were used by the contractor for the purpose of sinking the cribs, in place of the usual method of loading with stone. The cribs were framed in 100-ft. sections at the contractor's yard, 6 mi. away from the site of the work, to a height of 6 ft., when they were launched from a dock about 8 ft. above the water, then built up to the full height, and towed to the site of the work.



SINKING A 100-FT. CRIB SECTION

The site is prepared by first cleaning off the overlying material to the rock, which is at a depth of 34 ft., then filling the trench so that the water on the site is 26 ft. deep. The cribs are then towed to the site of the work by three tugs. The velocity of the current is about 7 mi. per hr. here. Owing to this extreme current, it was necessary to adopt unusual methods for holding the cribs in place during sinking. The large plant of the contractor made it possible for him to adopt the method as indicated in the view showing a crib section being sunk. It is butted up against a drill boat supported on four spuds, with the floating derrick on the other side of the crib, and was further controlled by hawsers run from a dredge. The derrick is shown loading the concrete blocks onto the crib for the purpose of sinking. These blocks were cast with a projection which fits between two lines of parallel stringers on the top of the crib work. The appearance of the stringers is shown in the foreground of the view. After the crib is sunk and filled with broken stone, and the concrete blocks are removed, the cribs are shimmed and leveled, after which the blocks are put back on a perfect line, and the mass concrete is placed.

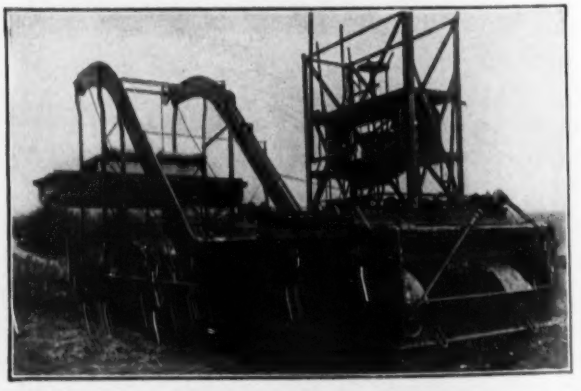
Concreting is done with a floating mixer and tower, using a 1-yd. batch which is handled every 1½ min. Concrete forms are handled by a derrick, and built so that sections 25 ft. in length may be run at one time.

The pier is riprapped on the river side, to prevent any action of the ice which, during the spring, passes down the river in great quantities and with great velocity.

A Power Scraper-Excavator

A new excavating machine, designed for excavation on the class of work for which wheeled scrapers and elevating graders are commonly employed, is shown (with housing not completed) in the accompanying cut. The two special features are the use of a power-operated scraper bucket, and the hauling of the machine by a cable. The cable is attached to a drum on a 24-ton traction engine which is anchored in place while hauling. This gives greater power and a steadier and more effective pull than if the engine were coupled directly to the excavator. The machine is the invention of L. C. Wood, and is being introduced by L. C. Wood & Co., of Alden, Iowa.

The excavating machine proper is 8x38 ft. over the frame and weighs about 12 tons. At the forward end is a gang plow, with seven plows which can be set to cut at any depth from 6 to 12 in. Between the frames is a 5-yd. scraper bucket attached to a carriage (shown just above the rear wheels), having four 12-in. wheels which travel on a track on the sides of the horizontal and inclined girders. The scraper is operated by cables from the traction engine. These lead under the front end of



A POWER SCRAPER-EXCAVATOR

the machine, then up over sheaves at the ends of the inclined or gooseneck girders, and down to the front end of the scraper. When the scraper is at the rear end of its travel its carriage is locked to the frame.

When ready to work, with the traction engine anchored ahead, the plows are adjusted for the required depth of cut, and the machine is hauled forward 7 ft. by the cable. The scraper is then hauled ahead to take its load, and is run up the inclined track and dumped into the box of the transverse conveyor. It then runs back to the end of the machine and is locked while the machine is again pulled forward. It is intended to handle 80 to 100 loads per hour.

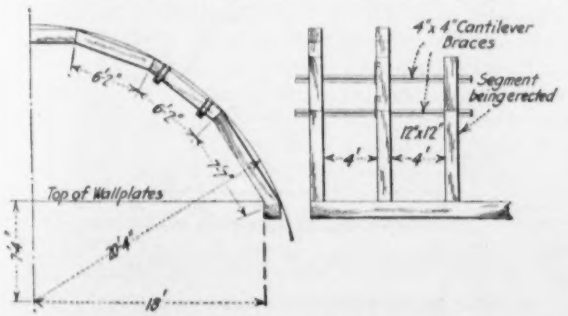
The conveyor has a box 5x7 ft., 2 ft. deep, with a separate bottom carried by flanged wheels. This can be run out on either side of the machine, to dump into a spoil bank or into wagons, and when in this position is run back so as to drop the entire load. Thus wagons are loaded at once, and do not have to drive along with the machine while being loaded gradually from a conveyor.

A small gasoline engine on the machine furnishes power for operating the conveyor, steering the machine and raising or lowering the plows. Three men are required; two at the traction engine and one on the machine to control the scraper and conveyor movements. The machine has been used experimentally in stripping a quarry site where the earth was 12 to 24 in. deep, with numerous boulders. This work was done during wet weather, the machine working in mud most of the time.

Speed of Tunnel Timbering Increased by Using Erection Outlookers

A novel scheme for increasing the rate of timbering was used at the Kennerdell (Penn.) tunnel of the Pennsylvania R.R., now building on the Allegheny division between Buffalo and Pittsburgh. The rings of timbering are spaced 4 ft. apart; each ring consists of seven segments, as illustrated.

The common method is first to tack the hip segments in place and then to set the other blocks in position, one by



Method of Timbering Kennerdell Tunnel, Using Outlooker Supports

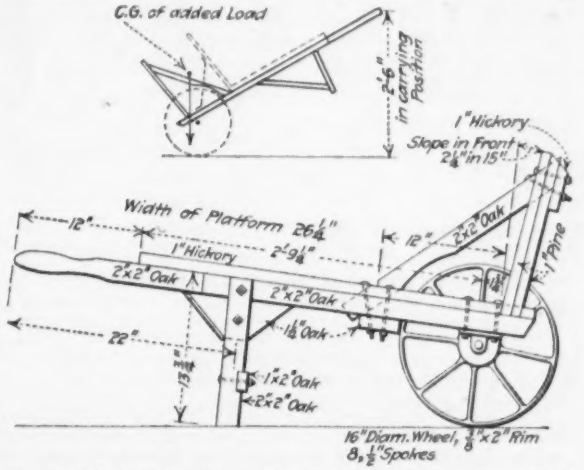
one, propping them up by temporary braces until the key-piece has been placed. By the new scheme only the first few rings have to be erected in this manner. For erecting the others, steel stirrups of the design shown are hung on the completed ring, and 4x4 outlookers are seated in them to hold up the segments of the ring to be erected. The upper end of the stirrup is pointed to grip the wood.

From Oct. 12 to Dec. 31, 1914, the progress of the timbering in the north end amounted to 745 ft., using the new method. In the same period the timbering in the south end was done by the old method, and the progress was 40 ft. less. The contractor, the John A. Kelly Co., offered a bonus of $100 if 200 ft. of timbering were put in on either end in December; 202 ft. were placed. Before this method was employed the rate of timbering was less than 150 ft. per month. The method is said to have been devised by Richard McGuckin, superintendent for the contractor.

NOTES

Special Wheelbarrow for Floor Terra Cotta—On the new Equitable Building, which is being constructed by Thompson-Starrett Co. at 120 Broadway, New York City, an interesting problem in handling fireproof tile presented itself. This tile is used in all floor arches and partitions and for steel protection. Its handling constitutes a very large item of labor cost.

The tile is unloaded from trucks by hand to barrows or placed in floor piles to be loaded later and wheeled to electric hoists to be sent to the floor where needed. A waiting gang unloads and distributes them, sending back empty barrows. Other methods have been tried but this is the usual practice. The large amount of labor used in transporting is apparent. It



was found that due to the bulkiness of tile the men wheeled only from 180 lb. to 250 lb. per barrow, as against from 250 to 450 lb. of other material; also, that the hoists, whose capacities are 1200 lb., were carrying but 660 lb. when loaded with tile. The writer therefore designed a modified form of wheelbarrow, which later proved successful in use. The barrow carried from 20% to 60% more weight without extra effort, by balancing the load or carrying the added weight over the wheel.

The rim of the wheel is made wider, adding stability, and there is room on each side of it for a tile block (all blocks have one dimension 12 in.) without interfering with the wheel. Omitting side casing at the wheel keeps it clean. The handles are shortened and spread and legs placed forward and spread. With these improvements, the center of gravity being low, the barrow is as steady as barrows for other materials of equal capacities. Patent has been applied for.—Frederick T. Warner, Thompson-Starrett Co., New York City.

Rattler Tests of Concrete for Roads—Before the recent meeting of the Minnesota Surveyors & Engineers' Society, Prof. C. F. Shoop, of the Department of Experimental Engineering of the University of Minnesota, described some rattler tests for concrete to be used in concrete roads. Reinforced-concrete rings of an outside diameter equal to the diameter of the rattler and inside diameter some five or six inches less are cast of different materials and with different conditions of construction, and are subjected to the usual rattler test. The reinforcement is added to make the rings more easy to handle. So far only a few such tests have been made, but enough work has been done to show the value of the test as a comparative indication of the wearing qualities of concrete under approximate road conditions.

Coefficients of Errors in Azimuth—The U. S. General Land Office in its "Standard Field Tables" gives a table entitled "Coefficients for Computing Errors in Azimuth Due to Small Errors in Declination or Latitude, Tabulated for 1′ Errors."

A surveyor who has projected his line by a solar observation, and finds he has used an incorrect latitude or declination, can turn to this table, using the proper latitude and hour angle, and find the error in his line resulting from each 1′ of erroneous setting. The total error in azimuth is found by multiplying the coefficient for 1′ by the number of minutes error in latitude or declination. Of course, too large an error in setting cannot be corrected in this manner. I have used it for correcting 20′ errors. This table gives the error-coefficient from six to two hours before or after meridian passage only.

I have tabulated the errors for observations made one-half hour and one hour either before or after noon. It would seem from this table that Gurley's "Manual," which says,

> It is best not to take the sun in the morning and evening when it is within half an hour of the horizon, nor at noon for about the same interval before and after it passes the meridian,

is claiming too long a working day for the solar method to secure acceptable results.—H. N. Bradstreet, Aguila, Ariz.

COEFFICIENTS OF ERRORS IN AZIMUTH, TABULATED FOR ONE-MINUTE ERRORS IN LATITUDE OR DECLINATION

	Error in Lat. Arc. Hours from Noon			Error in Decl. Arc. Hours from Noon		
Lat.	½ Resulting Error in Azimuth	1	2	½ Resulting Error in Azimuth	1	2
25°	8.38′	4.12′	1.91′	8.45′	4.26′	2.21′
30°	8.77′	4.31′	2.00′	8.89′	4.46′	2.31′
35°	9.27′	4.56′	2.11′	9.36′	4.72′	2.44′
40°	9.92′	4.87′	2.26′	10.00′	5.06′	2.61′
45°	10.74′	5.28′	2.45′	10.83′	5.46′	2.83′
50°	11.82′	5.81′	2.69′	11.92′	6.01′	3.11′
55°	13.24′	6.51′	3.02′	13.36′	6.74′	3.49′
60°	15.19′	7.46′	3.46′	15.32′	7.73′	4.00′
65°	17.97′	8.83′	4.10′	18.13′	9.14′	4.73′
70°	22.29′	10.91′	5.06′	22.40′	11.30′	5.85′
	Formula: $\text{error} = \frac{c\ t\ P}{\sin s}$			Formula: $\text{error} = \frac{1}{\sin s \sin P}$		

where P is the hour angle, and s is the colatitude.

The two formulas are derived from $\cos z = \cos p \cos s + \sin p \sin s \cos Z$ by transposing:

$$\cos Z = \frac{\cos z - \cos p \cos s}{\sin p \sin s}$$

and finding the first derivative of Z, first with respect to z and second with respect to s. In the formula Z = angle of azimuth, z the pole distance of the sun.

Concrete Lining for a Brick Tank forming part of the water-works plant at Elkhorn, Wis., has been employed to strengthen the tank and make it waterproof. The brick storage tank is 20 ft. diameter and 28 ft. high, with its base 22 ft. below the ground. It was built about 20 years ago and has been in bad condition, so that ground water seeped in and the storage water leaked out. Two sets of forms were made, 3 ft. high, and in eight sections for the complete circle. These sections had 1-in. t.-&-g. sheeting, with 1x6-in. boards at the ends, and three horizontal ribs cut from 1-in. planks. The face of the form was 4 in. from the brick. Wire netting was wired to 60-d. spikes driven into the mortar joints, with their heads projecting about 2 in. A 14-in. concrete floor was laid in advance of the lining, and during the latter work the seepage was so great that a pump had to be kept in operation.

The concrete was 1 : 5, with pit-run gravel. It was made to a mushy consistency and spouted directly from the mixer into the forms. One form was filled each day, the form beneath (over concrete about 40 hr. old) being removed and replaced above the one just filled. The work was done during cold weather (February, 1914). At the end of work each day the wooden cover of the tank was replaced, and a pipe was led to the inside through which live steam was discharged. The contractor was A. G. Olsen.

Factors Responsible for Poor Concrete Pavements—(1) No rolling of subgrades, even on fills up to 20 ft. in depth. (2) No wetting of subgrade immediately preceding placing of concrete on the hottest of days. (3) The use of unseparated and unwashed aggregates more commonly called pit-run material used in proportion of the sum of two aggregates when separated. (4) The most careless handling and protection of the aggregates until such time as they are mixed with the cement: I have seen aggregates piled alongside the road, so dust-covered and so thoroughly mixed with dirt from teams driving over them that at first glance one would think these piles of aggregates were simply dirt excavated from the subgrade. (5) Dirty and unclean water used. (6) The concrete poorly and carelessly mixed, handled and placed. (7) The concrete burned and dried too quickly by reason of no covering and lack of wetting down and keeping wet after placing. All of the above conditions are facts, and are factors that tend to make for poor results and are the results of mistakes in judgment, ignorance, and lack of study of the correct methods to be followed.—"Concrete Pavements in Washington," compiled by Reitze, Storey & Duffy, Inc., Seattle, Wash.

City Survey Monuments in or near the center of the street have certain disadvantages as every engineer who has tried them knows. Witness the following policeman's report:

PORTLAND POLICE DEPARTMENT

2-9-1915.

Captain Moore

At East 12 & Tillamook St. there is a Surveyors Tumb in the center of the intercection of the street with the cover broke and it leaves a hole in the street a little over a foot deep and this should have a new cover on it as a horse may step in there and break his leg.

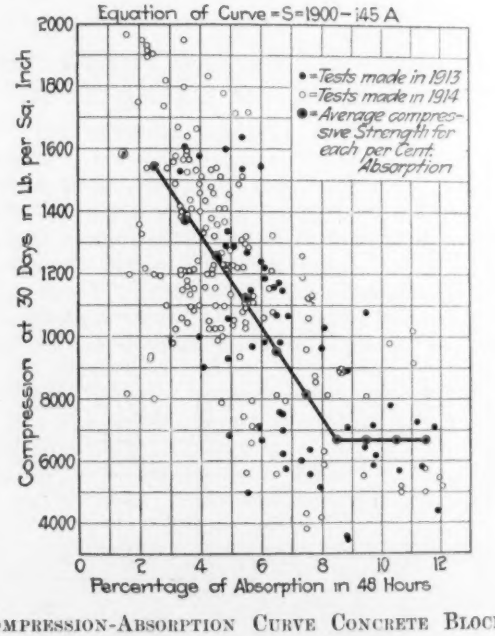
Officer H. S. Raney

Relief—Day

This report found its way to the city engineering department, and the cover of the surveyors' tomb was replaced before any damage was done to horses' legs or to the public health.—Orrin E. Stanley, Portland, Ore.

Compression-Absorption Relations in Concrete Blocks—The Division of Buildings of the city of Cleveland, Ohio, for the last two years has been testing the concrete blocks used in that city. Among other properties tested has been the relation between the compressive strength of the blocks and their absorption capacity. Data on 218 such tests are given in the accompanying diagram. In explanation of the curves, V. D. Allen, Commissioner of Buildings, offers the following:

All tests for each 1% have been averaged and this average marked by a circle within a circle. It will be observed that from 2½% to 8½% absorption these average points fall in a sloping straight line and that from 8½% to 11½% they fall in a horizontal straight line. The point between 1% and 2% was the result of but three tests, and therefore cannot be relied upon as being accurate, as it is believed the tests so far made which fell under 2% have been more or less freak blocks.



COMPRESSION-ABSORPTION CURVE CONCRETE BLOCKS

In order to see whether any improvement in the class of blocks is being made, all the tests for each year have been averaged around both axes and the point so found marked with a circle and cross within. It will be observed for the year 1913 the center of gravity of all tests is just under the 900 lb. per sq.in. strength line and just above 9% absorption, while the center of all tests for 1914 is just above the 1200 strength line and just under the 5% absorption.

Concrete Estimating Tables for the rapid estimating of quantities have been just issued by the Koehring Machine Co., of Milwaukee, Wis. They comprise tables for the determination of amounts of cement and aggregate required for concretes of different mix and for the estimating of the cubage of footings, columns, beams and slabs. The arguments in the tables are in such small units that interpolation will be rarely required.

Editorials

Age Defects in Buildings

Has age or length of service any inherent weakening effects on buildings? Rust and rot are not in question, nor that kind of settlement which cracks brick and stone walls and saps their stability. None of these latter influences affected the Boston warehouse whose collapse is reported on our news page this week. So far as present findings show, the building simply shrunk and warped and shook itself apart—while carrying a heavy load, perhaps an overload.

In ordinary language we are apt to apply the terms wear and tear and racking effects of long service to a building as well as to a machine or a wagon. But that is a sort of poetic license, for we really expect that a well-constructed building will last indefinitely—that it will become obsolete and be torn down to make way for a successor, rather than fall down. When structural weakness develops, we therefore conclude that the original builder is at fault, that he had not put up a well-built structure.

Unfortunately, obscure or mysterious accidents to ordinary buildings, which do occur now and then, are always—we recall no exception—left uninvestigated, and do not supply a moral for bettering future practice. So for instance it is believed that gross overloading is not at all rare in some classes of commercial buildings; yet no failure or accident has ever been made the means of demonstrating the fact and the dangers of overloading. Had we such demonstrations, brought out by the investigations of the public building authorities in a case of collapse, law and practice would recognize much sooner the need of such protective means as certificates of occupancy for commercial buildings. In the same way we lack many teachings of experience as to various details of building construction and some broad questions of building practice. The theoretical advantage of construction in which all elements are tied together into a rigid, co-acting unit has never found recognition in rules of practice, and has never been credited by legal allowance with superior strength and safety because of the same neglect.

We look to the Boston building authorities, therefore, to establish the circumstances and causes of the warehouse collapse as fully as can be done after the fact. Where in the case of a small community it might be natural that no study of a collapse should be made, or at least no valuable results gleaned by the study, the matter is otherwise when a city so large and so prominent as Boston is involved.

A Good Way to Distribute River and Harbor Appropriations

At the session of Congress which ended on Mar. 4, the same sort of river and harbor appropriation bill was adopted as at the previous session. Instead of passing a bill giving an allowance of so many dollars for each piece of work to be undertaken, Congress appropriated a lump sum, "to be expended under the direction of the Secretary of War and the supervision of the Chief of Engineers for the preservation and maintenance of existing river and harbor works, and for the prosecution of such projects heretofore authorized as may be most desirable in the interest of commerce and navigation, and most economical and advantageous in the execution of the work." Allotments to the several projects from the lump sum appropriation of $25,000,000 are to be made by the Secretary of War upon the recommendation of the Chief of Engineers.

As most of our readers are aware, this reform in procedure was adopted by Congress, not of its own volition but under the compulsion of necessity. The majority of Congressmen are extremely desirous of going back home to their constituents with a report of what Federal appropriations they have been able to secure to be expended in their district; and this is apparently the beginning and the end of their interest in the river and harbor bill.

The remarkable attack made by Senator Burton last year upon this old method of making appropriations has, however, had such effect that neither at that session nor at this year's was it possible to pass a river and harbor bill swollen with appropriations for all sorts of foolish and wasteful projects as in previous years. Faced with this situation, the Congressional leaders wisely determined to appropriate a lump sum for the river and harbor work and leave to the Chief of Engineers and his staff the responsibility for its apportionment.

It is a heavy responsibility to place upon the engineer-officers unquestionably; but anyone familiar with the situation will agree that these engineers are far better able to judge where money can be spent with the greatest benefit to navigation interests than are the individual congressmen.

Some Remarkable Projects for Inland Navigation

Congress did well to relinquish to engineers the responsibility of distributing the money to be spent on actual construction work. It appears, however, that something had to be done for which the individual congressmen could claim credit on returning to their districts. There was tacked on, therefore, to the end of the river and harbor bill a clause reading as follows:

> **Sec. 15. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following localities, and a sufficient sum to pay the cost thereof may be allotted from the amount provided in this act.**

Then follows a list of over 200 localities extending from Maine to Alaska. In most cases nothing is stated but the locality, as, for example, "Hendricks Harbor, Maine; Mianus River, Conn.; West Creek, N. J.; Crum River, Penn.; Wisheating Creek, Fla.; Hatchee River, Tenn.," etc.

What the examination and survey is for is in most

of the cases not stated; and it may be said perhaps that Congress was again relying on the engineers to investigate and recommend whatever improvement seemed wise.

It is, of course, impossible to criticize indefinite recommendations of this sort; but if the character of the whole list of projects could be judged by some in which the purpose is definitely stated, criticism could hardly be too severe. One of the projects of which an examination and survey are ordered reads as follows:

Sebethe River, Conn., from its mouth to a point at or near the City of Bristol, Conn., and canal from a suitable point on the Sebethe River to New Britain, Conn.

If you search for the Sebethe River on an ordinary map of Connecticut, you will search in vain. The State Board of Health of Connecticut, however, has just issued a report on stream pollution from which we learn that the Sebethe River is a little stream a dozen miles long, extending from Middletown, Conn., back to Berlin. At Berlin its average flow during the low six months of the year is 10 cu.ft. per sec. It does not reach Bristol at all, that town being located a dozen miles distant on another rivulet known as the Pequabuck, with a flow during the low six months of 15 cu.ft. per sec.

How the Sebethe River could be made navigable, even for canoes, to Bristol, located across a divide in another drainage basin, will puzzle those who make the survey.

Another ambitious project for inland navigation is described as follows:

Shetucket and Quinnebaug Rivers, Conn., and French River, Conn. and Mass., with a view to securing slack water navigation between Norwich, Conn., and Worcester, Mass.

The Quinnebaug River is a swift stream with a discharge where it empties into the Shetucket, a few miles above Norwich, of about 400 cu.ft. per sec. Where it receives the French River, about 25 miles upstream, its flow is about 130 cu.ft. per sec. The French River has a total drainage area of 70 square miles, and its flow where it crosses the state line is about 60 cu.ft. per sec. It is a very rapid stream, with many dams and mill ponds on it. The small brooks at its source about 20 miles north are several miles west of Worcester, which is on the headwaters of the Blackstone River, in another drainage basin.

Engineers will understand, of course, that the flows above given are average rates of flow for the low six months of the year and that the minimum low-water flow is a very small fraction of this average. It is evident that in periods of drought none of these rivers would float a canoe. To create slack water navigation on them it would be necessary to pump the water from Long Island Sound.

Such examples as these add force to the demonstration that Congress is incompetent to deal with the details of navigation improvement works and had better leave the whole responsibility to the engineers.

American Water Powers and the Nitrogen Industry

For years American water-power promoters have been deeply interested in electrochemical industries which promise long-hour and off-peak load for hydro-electric stations. For various reasons the subject of artificial "nitrates" seems to have a wider appeal than any other in this field, and usually it is on this industry that owners of water rights first fasten their vague hopes. Innumerable sincere but misguided efforts have been and still are being made to secure the location of plants for the fixation of atmospheric nitrogen near developments of a few thousand or even several hundred horsepower capacity. Therefore it is of service to point out some evident tendencies of the American nitrate situation. This should be done particularly at this time because of the unusual interest aroused by our recent description of the plant and processes of the first commercial nitrogen works in America ("The Cyanamid Works at Niagara Falls," Jan. 7, 1915), which indeed presented the first authentic and adequate notes on the adaptation of this process to American industrial conditions.

The far-reaching effect of the plans of the American company may now be studied from the paper of its president, Frank S. Washburn, recently given in New York before the American Institute of Electrical Engineers and the American Electrochemical Society and briefly abstracted elsewhere in this issue.

This concern is confining its developments to cyanamid, in spite of its continued research and study in nitrogen processes generally. This narrowing of present choice on the part of the only American producer of artificial nitrogen products is easily explained. The very low efficiency of the arc processes for oxidizing atmospheric nitrogen compared with the cyanamid and synthetic-ammonia processes probably puts the first out of the running in this country, where the very large amounts of power needed cannot be secured cheaply enough. The ammonia process has been successfully instituted by the Badische Analin works in Germany because of their creation of nitrogen and hydrogen byproducts and their need for ammonium sulphate.

At present the final product of commerce from the cyanamid process is the cyanamid itself. If this were to continue to be the end product, there might be some chance for distributing the production of cyanamid at powers near industrial districts and the centers of agricultural areas. But cyanamid is not regarded as the compound to be ultimately employed in agriculture, and seemingly it cannot rival one of its derivatives for that field. The few and small plants left to produce cyanamid for the industries could not compete against the organization and equipment of the $35,000,000 works which the American company seemingly contemplates.

The new agricultural chemical which probably is to be the ultimate market product is an ammonium phosphate. Its production necessitates the use of large quantities of phosphate rock, which occurs only in Florida and Tennessee, so far as known, and can stand only the cheapest water transportation. The development of the industry in this direction means that the water power which supplies it with energy must be separated from some deep waterway by no great transmission distance.

The economic situation back of all this has been very carefully discussed by Mr. Washburn. His conclusion is that the same results will be attained as now are seen in our meat-packing industry, where live cattle are shipped in enormous numbers over long distances to the abattoirs in Chicago, Omaha and Kansas City, and yet dressed beef is put down in North Carolina cheaper than the local butcher can slaughter a steer on the edge of town and peddle the products from his cart.

The hope of American water-power promoters, then, cannot profitably be centered at this moment on the atmospheric-nitrogen industry. A few in the course of time may reap some benefit here, but their projects must

be large and unusually accessible. The great majority must look farther for those smaller and more special electrochemical industries which do not use coarse and geographically undistributed materials, which employ more simple and inexpensive enough processes so as not to be tremendously imperiled by large consolidations of investment and organization, and which put out market products of high enough value in proportion to weight to stand considerable transportation burdens. These desiderata may be exhibited by comparatively few electrochemical industries, but the search for new schemes and the redevelopment of old ideas give much promise. The general clustering of electrochemical plants around water powers would benefit all industry, through the cheapening of power, reduction of fuel consumption and expansion of business. So important would be the growth in this direction, and so difficult its attainment, that its hastening can profitably be fostered by government bureaus like the Geological Survey or the Bureau of Mines, or by the Department of Commerce.

Do Floor-Arches Exert Thrust?

In coming out boldly with a demand that tile floor-arches should have enough tie-rods put in to resist the thrust of the arches, F. N. Kneas in his article in this issue flies in the face of conventional practice. This practice is to put in only as many rods as seem convenient or as are required by some rule-of-thumb. That the thrust of floor-arches can be figured, and even that tie-rods are a very necessary or important element in the strength of floor-arches, are ideas commonly looked upon as Quixotic. To those who have no personal connection with the design of buildings it might seem a fundamental principle that such arches should have ties capable of absorbing their thrust at a fair unit-stress. But they are confronted by the fact that arches built in violation of this principle continue to stand up, some of them even under a considerable overload. Most architects and some structural engineers assert very positively that tie-rods in floor-arches are entirely unnecessary.

The thrust of a floor-arch depends upon its effective depth. What is the effective depth of a tile floor-arch? We confess we do not know, although we would be willing to assume a greater depth than that computed by Mr. Kneas in his article. We believe that an argument can be made for taking a depth of 10 in., or even 11 in., as the effective depth of a 12-in. tile arch. That this question of depth is at all doubtful illustrates how little definite thinking and calculation have been done concerning tile arches. With the depth of arch decided upon, it is a simple matter, of course, to compute the theoretical thrust.

At this point we come to the difference between two classes of people—those who do not believe that an arch exerts thrust, at least when this arch is a floor-arch, and those who believe that whatever thrust a floor-arch may exert will be taken care of in some way by the general cohesion of the structure, without the need to waste money on tie-rods. As to the first class, we confess to being unable to answer their objection. It is more necessary to think of the objections of the second class, namely, that tie-rods are unnecessary.

It is easier to think of the doubts and questions concerning this subject by referring to a concrete example. In two buildings intended to carry the same floor load, with floor-beams set at the same spacing, and with the same depth of tile arch, approximately six times as much tie-rod area was provided in one case as in the other. In the building containing the smaller amount of tie-rod area, the tie-rods were put in by rule-of-thumb, while in the other case they were designed by calculation for a conservative stress at root of thread.

Mr. Kneas' argument, which favors the kind of design represented in the building with the larger amount of tie-rods, is undoubtedly logical. Yet we need to take note of the fact that the other building stands and shows no evidences of insufficient strength. There is room for interesting discussion as to what represents sound practice in this field.

We venture to suggest that the cohesion in a tile-arch floor and the rigidity of the steel framing are contributing factors in holding the arch up to its duty. The value of these factors is unknown; we cannot figure with it, but can only gamble on it. The difference between the view presented by Mr. Kneas and the conventional practice may therefore be the difference between the designer who aims to provide definite strength for definite loading and the optimist who is willing to gamble on the various chances that *may* help his structure to stand up.

Letters to the Editor

Engineers as Members of Public Service Commissions

Sir—In ENGINEERING NEWS of Feb. 18, I was much interested in the editorial comment on Gov. Whitman's appointment of a lawyer as head of the New York State Highways Department. Better things were expected of him; but it was no surprise that Governor Major of Missouri appointed a lawyer as County Surveyor of Jackson County, for I do not believe any one out here would be astonished if he appointed a blacksmith to be superintendent of a state insane asylum.

As long as the laws do not clearly state the qualifications a man must have to hold a position, a president, governor or mayor will appoint any one to office who has aided in his election or who can help his future political aspirations. This will doubtless continue until the people demand a change in the laws or in the power of appointment, so that no one can be appointed to office who has not the knowledge and experience qualifying him to fill the position.

There have been many editorials of late discussing why investors have been so timid about buying securities of public-service companies. This is not strange, however,

when a close examination is made of the qualifications of the class of men that are appointed on public service commissions. It is believed an examination will show that most of the commissioners appointed have had no previous experience or knowledge concerning the operation of the properties they are to regulate. A frank public admission of this was made by Commissioner Cram, of New York, when he testified before the Senate Committee a few days ago as follows: "You aught to have efficient commissioners but you haven't got them. I don't claim to be efficient; but they shouldn't be the buffet of politics."

This statement by a member of what the general public supposed to be the best state commission in the country will give another general chill to investors and make it more difficult for companies to sell securities in order to improve and extend their properties.

Let us go a step farther and ask what class of engineers, accountants, etc., will be employed by an incompetent commission to value their properties for establishing rates. It is well known that men are employed by some state commissions as engineers (through a pull) who have never been in an engineering institution a day in their lives and have never designed or built a dog kennel. Their engineering experience has been as timekeepers or storekeepers or bookkeepers in some engineering or contracting office; yet they are passing on the values of properties costing millions of dollars for rate-making purposes. When this is so generally known, it is no wonder public-service securities are no longer sought after by investors.

Doubtless regulation of public utilities in some form is here to stay, and I believe it would reëstablish public confidence in its fairness if a state commission were required to consist of five members appointed for terms of five or ten years, and made up as follows:

First—An all-round experienced business man;
Second—An experienced operating man;
Third—An engineer who has had a general practice in designing and constructing public-service properties, together with operating experience;
Fourth—An attorney who has had long experience in corporation law;
Fifth—An experienced expert accountant.

New York's coming constitutional convention will have a fine opportunity to provide in the new constitution the qualifications that members of a commission must possess. Such a constitutional provision would help remove the commissions from politics.

CHAS. H. LEDLIE.

Rialto Building, St. Louis, Mo., Feb. 24, 1915.

Sir—Referring to your editorial of Feb. 18 in regard to lawyers doing engineering work, there is nothing new about that. This town has been in a controversy "engineered" by the lawyers for twelve or fifteen years over the purchase of water-works. The franchise provided for selecting three engineers as arbitrators. Objection was raised on the ground that they would be "bought" by the water company. The attorneys for the city insisted on having three lawyers.

I suggested that if the only desire was to have honest men they would better get three preachers.

HORACE M. MARSHALL.

Vicksburg, Miss., Feb. 27, 1915.

P. S.: Two members of the American Society of Civil Engineers within the last sixty days have settled the matter.—H. M. M.

A Suggested Warning Against Cold Weather Concreting

Sir: The writer read with much interest the article in ENGINEERING NEWS of Dec. 31, 1914, on the failure of the Hippodrome Arcade at Youngstown, Ohio. Of especial interest are the temperature curves appearing on p. 1329.

In this connection the writer would quote from a signed article by C. A. P. Turner appearing in your issue of Dec. 24, 1911, giving the standard specification used by him as follows:

> Whenever the temperature drops below 45 deg. F., and before it reaches the freezing point, the water used in the mix shall be heated to 110 deg. F. . . .
>
> The best portland cement is readily chilled and becomes dormant at temperatures materially above the freezing point and workmen, considering that no harm is done providing the concrete does not freeze, are prone to regard two weeks' time in the chilly fall weather as the equivalent of two weeks' time in the dry summer with disastrous results. The simple precaution of waking up the cement by the use of warm water in the mix causes it to deport itself more nearly as it does in the summer season.

If on the Youngstown temperature chart the line marking temperature 45° is made a heavy one, it will

DISPLAY SIGN WARNING AGAINST FOREST FIRES

(Original is in reds and blues and is 11x14 in. in size. Suggested as a type of display which might be useful to insure more care in placing concrete in cold weather)

be seen that on 16 of the 30 days preceding the accident the temperature fell below Mr. Turner's critical 45° and that 7 of these 16 immediately and consecutively preceded the day on which the failure occurred.

While the area below the 45° line is small it reduces by just so much the positive area above the line; so that it seems not by any means a far-fetched conclusion to charge this failure to the slow setting of cement due to temperature even though much of the time there was little freezing.

The writer does not pretend in this letter to be adding anything new to the subject of concreting, but merely to lay some additional emphasis on the fact that it is temperature 45°, and not 32°, on which the engineer and contractor must keep their eyes if they would avoid trouble.

Those who have traveled through forest reserves of the West cannot have failed to observe the notices, some of them displaying no little originality in their get-up, warning campers and others against the danger of starting fires. One of these is herewith reproduced.

Something of this nature might with advantage be adapted by building inspectors for, say, postal-card distribution, to warn contractors of the danger of concreting when the temperature is below 45°, or possibly some building inspectors need some such alarm clock themselves. Possibly, too, some of our friends, the cement manufacturers, could help by giving away advertising thermometers with the critical 45° in large red figures or otherwise conspicuously marked.

H. A. Rands.

Portland, Ore., Feb. 11, 1915.

Why Suction Should Be Considered in Designing for Wind Stresses

Sir—I have been reading with much interest the articles of R. Fleming on "Wind Loads and Stresses," in your recent issues.

I am very much disappointed in that Mr. Fleming endorses the old conventional wind-load units, and that he does so on the ground that while they are not scientific they are safe.

My papers before the Western Society of Engineers in 1911 and 1912, which Mr. Fleming quotes, were progress reports only, but on Dec. 8, 1913, I made a report of my last series of tests (Fig. 1 reproduces a few of the resulting diagrams) and made a definite recommendation (Fig. 2) in regard to wind loads. This last paper contained tables of comparative stresses in arches and Fink trusses which show that by my proposed units *all* members of both arch and Fink trusses receive a compressive stress, while by the old methods three members can never have compression. Careful designers, it is true, do make all members capable of resisting compression, and so long as one is dealing with trusses of conventional shape and ordinary size the old method gives safe designs. But in the unusual case the use of loads *known to be greatly in error* is likely to lead to unsafe design.

Mr. Fleming does not say, but many doubtless will, that many trusses have stood up for years with these members made of rods. To such an argument one might answer that the owner paid for a factor-of-safety which he did not get.

Mr. Fleming does note, however, that the saving in steel

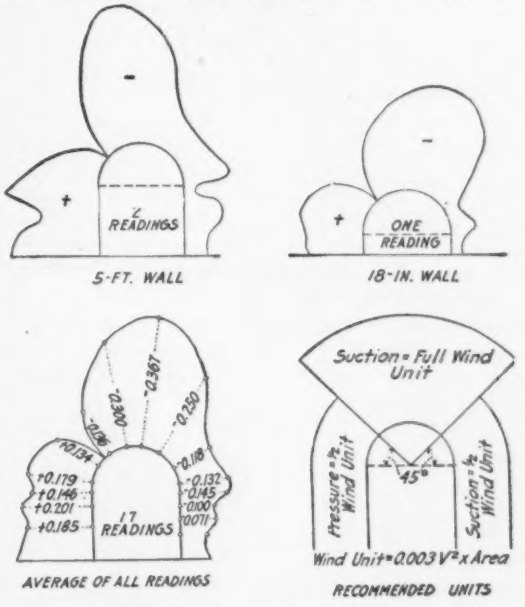


Fig. 1. End Elevation of Test-House, with Wind Pressure and Suction Readings Plotted Radially

is not large when suction is regarded. I will agree that the economy in truss members is unimportant. But I venture to say that anyone who designs his girts and columns and kneebraces by the old method is wasting a large amount of steel.

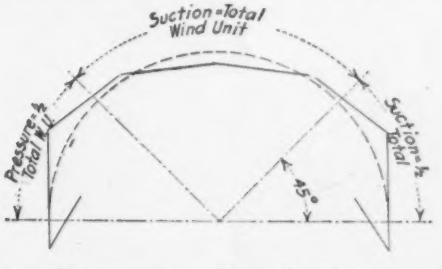


Fig. 2. Recommended Wind Distribution on a Mill-Building or Similar Roof

Albert Smith.

Lafayette, Ind., Feb. 13, 1915.

NOTES AND QUERIES

In a news note in "Engineering News" of Feb. 11, 1915, p. 286, describing a fire in a cold-storage plant at Ft. Wayne, Ind., it was erroneously stated that the plant was equipped with automatic sprinklers. We are informed by the Chief of the Ft. Wayne Fire Department, Henry Hilbrecht, that the local newspapers, from which our information was taken, were not correct on this point.

In the note on proposed agreement on gas rates in St. Paul, Minn., it was erroneously stated (1) that in Minneapolis there was imposed a gross-earnings tax of 3c. per 1000 cu.ft., (2) that there was at present a water-gas plant with coal-gas works in prospect, and (3) that St. Paul imposed no gross-earnings tax and has a coal-gas plant of 2,000,000-cu.ft. capacity. These data should be interchanged for St. Paul and Minneapolis respectively.

Substructure for the Jackson St. Bridge over the Chicago River

The Jackson St. bridge is at a narrow part of the Chicago River and the substructure design for the new bascule bridge had to provide an auxiliary channel to give the same flow capacity as at other parts of the river. In the construction work it was necessary to keep the old bridge in commission as long as possible. This old bridge consisted of a three-truss steel swing span 280 ft. long and 58 ft. wide, the east arm of which crossed the navigable channel. The work was started by dredging this narrow part of the river to a depth of 30 ft.

The west arm of the bridge spanned property of the Pennsylvania R.R. adjacent to the freight station, with a bypass 50x17 ft. beneath it to provide an auxiliary channel for the flow of water on the west side of the center pier and the west abutment of the elevated railway bridge to the south. The arrangement of the substructures of the old and new bridges is shown in Fig. 1.

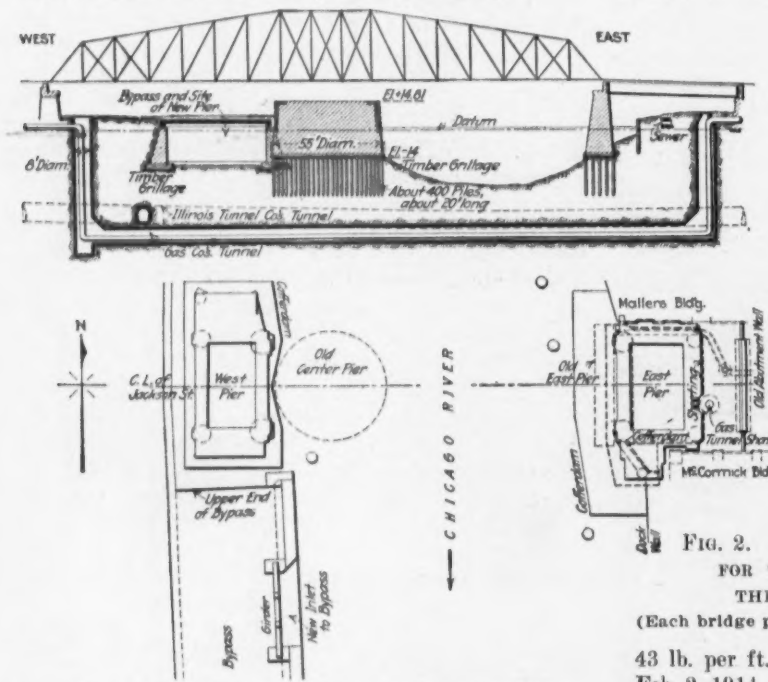


FIG. 1. ELEVATION AND PLAN OF OLD AND NEW SUBSTRUCTURES OF THE JACKSON ST. BRIDGE AT CHICAGO

To provide a site for the west pier of the new bascule bridge a portion of the bypass was removed, and to secure the necessary flow through the remaining part of the bypass an opening 38x17 ft. was cut through its east wall (south of Jackson St.), the concrete roof of the bypass being suspended over this opening by stirrups from a heavy steel girder about 46 ft. long (Fig. 1). To secure the least possible obstruction to the bypass, the west foundation for the new bridge is composed of two piers with an opening or waterway between them. In order to interrupt traffic across the old bridge as little as possible, the construction of the west coffer-dam was begun while the bridge was in service.

The new bridge is to be a double-leaf trunnion bascule bridge having a span of 202 ft. c. to c. of trunnions and 168 ft. clear channel opening. It will have one 37-ft. roadway and two 13-ft. sidewalks. The east abutment is to be supported by five reinforced-concrete cylinders 5 to 10 ft. diameter. The west leaf is to be carried by two piers parallel to the river channel and forming the additional waterway. The front pier is supported by two concrete cylinders 12 ft. diameter and one 5 ft. diameter, and the rear pier is supported by two concrete cylinders 9 ft. diameter and one 5 ft. diameter. All piers are carried down to solid bedrock at about 85 ft. below datum (water level in the river). The construction is shown clearly by the isometric drawing, Fig. 2.

WEST COFFER-DAM AND PIER—The west coffer-dam was constructed under the old bridge, just west of the center pier and in the space formerly occupied by the bypass. On account of the limited space available and difficulties of dredging around the piers, etc., the walls of this coffer-dam consisted originally of a single thickness of interlocking steel sheeting, inclosing a space 96x48 ft. The sheeting was 45 ft. long, and weighed

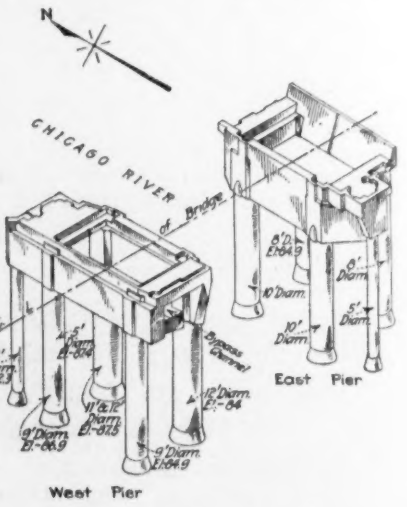


FIG. 2. ISOMETRIC ELEVATIONS OF THE PIERS FOR THE NEW BASCULE BRIDGE OVER THE CHICAGO RIVER AT JACKSON ST.
(Each bridge pier is supported on cylinder piers sunk to rock)

43 lb. per ft. This part of the work was started about Feb. 2, 1914. The heavy bracing, of which there are four sets, was framed and submerged within the coffer-dam. The dam was then pumped out (about Mar. 15), and the general excavation within carried down to about 19 ft. below datum.

The open wells for the three rear piers were sunk to about 39 ft., when, on account of bad ground, the water followed down and leaked under the toe of the steel sheeting and into the wells, filling the coffer-dam. Clay was then dumped along the west wall of the sheeting, where the leak developed. Drums were put in the wells and the lower sets of lagging jacked out well against the sides of the wells, and the usual other methods were employed to take care of the situation. But after the dam was again pumped to 19 ft. (about May 4), a similar leak occurred, filling the dam. As a tunnel for gas mains and another for a narrow-gage electric freight-railway system passed under the pier, special precautions were necessary.

A puddle-wall coffer-dam was decided on to take care of the situation, but the center pier of the old drawbridge was so close to the east wall of this coffer-dam that it was necessary to remove it before driving the outer line of sheeting. The wrecking of the old bridge superstructure was started therefore, and it was removed by cutting it apart with blowpipes, as described in ENGINEERING NEWS, July 9, 1914. The old masonry center pier, 53 ft. 9 in. diameter, and built on a timber grillage supported by pile foundation, was blasted and removed by a derrick boat and dipper dredge, this work being completed about the middle of July.

A second line of 45-ft. steel sheeting was then driven on the north and east sides of the coffer-dam, and puddle clay placed between the two lines. The remaining wall the rear ones to 22½ ft. below datum; that is, to the level of the connecting struts of reinforced concrete.

The excavation for the bottom slab of concrete was then made and the concrete placed by a floating mixer plant, consisting of ¾-yd. mixer, 65-ft. tower, boom, discharge pipe, hoisting engine, etc., mounted on one end of a deck scow, and served with material by a revolving derrick with a 2-yd. bucket mounted on the other end of the scow. This plant is shown in Fig. 3.

EAST COFFER-DAM AND PIER—On the east side two 8-story brick buildings on the river front were underpinned, the light pile foundations being replaced by concrete piers under the parts adjacent to the bridge. The approach girder span and old masonry abutment were removed and the site of the coffer-dam was excavated to

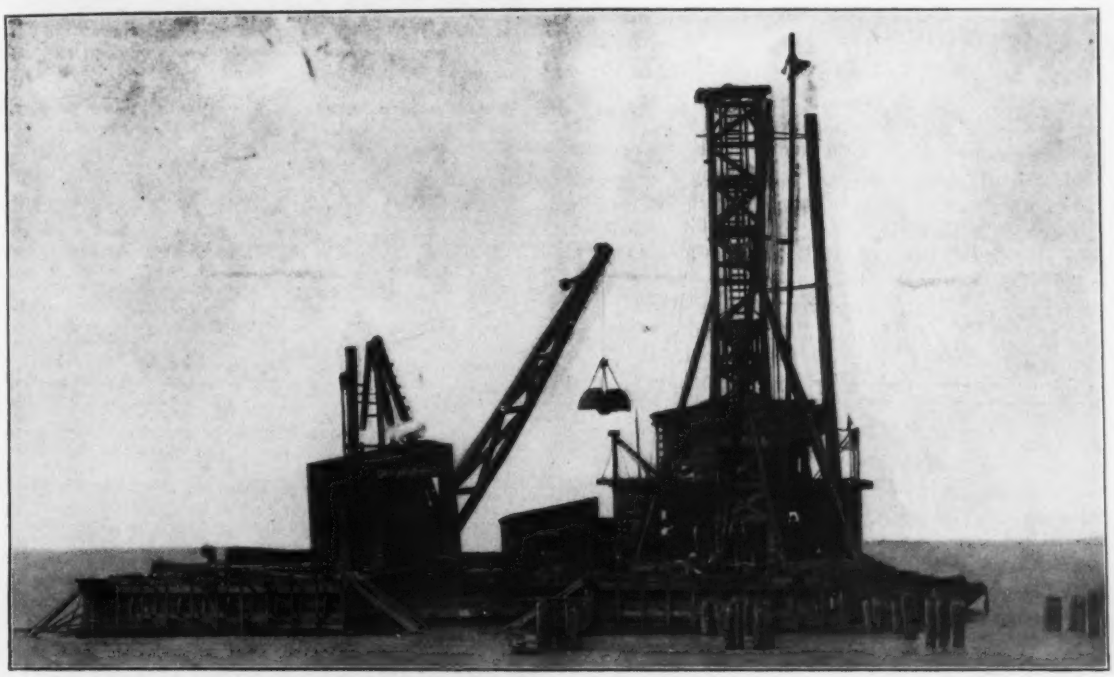


FIG. 3. FLOATING CONCRETING PLANT USED FOR THE SUBSTRUCTURE OF THE JACKSON ST. BRIDGE

(The scow has at one end the mixer and elevator tower with hopper and delivery spout. At the other end is a revolving crane with a clamshell bucket for handling the concrete material. The view shows the plant at work on the new Chicago municipal pier in Lake Michigan.)

of the old bypass, a few feet west of the coffer-dam, served for the outer wall on this side. On account of the entrance of the bypass there was not room to drive another line of sheeting on the south side, and it was thought that a single line would serve here, the ground being a little better.

Before completely filling the puddle wall with clay and some lighter material, additional clay was deposited with a dipper dredge against the outside wall of the coffer-dam, on the north and east sides, to protect it against the considerable current acting on the coffer-dam where the channel had been dredged to 30 ft. The coffer-dam was pumped out about the middle of September. Work was then resumed on the sinking of the remaining wells, the work being done by miners and followed up closely with lagging and rings in the usual manner. As the wells were sunk to bedrock they were filled promptly with reinforced concrete, the front wells being filled to 24 ft. and about 4 ft. above datum before any sheeting was driven. This coffer-dam is about 58x52 ft. inside, with an extension about 20x24 ft. on the southwest corner. The steel sheeting varies from 20 to 45 ft. in length. The river side is of the puddle-wall type, employing two lines of 45-ft. steel sheeting tied together by rods in the usual way.

Before doing any more excavation inside of this dam, and while the sheeting was being driven, the two 8-ft. wells in the rear of this pier were sunk to bedrock at about 85 ft. and filled with concrete to about 13 ft. below datum.

Three sets of bracing were used in this coffer-dam. The dam being pumped out, the various sets of bracing were placed as usual as the excavation proceeded within the dam. Before pumping out, a 36-in. sewer was diverted to a line about 20 ft. north and carried out to the river by a steel pipe placed in permanent position for the proposed concrete sewer. As the work proceeds the con-

crete will be run around this steel pipe. The two 10-ft. wells and the one 5-ft. well have been completed. The material was raised by the usual steam hoist to decks in towers about 30 ft. high and then carried by chutes to dump scows moored along the coffer-dam.

The bridge is being built for the Sanitary District of Chicago; Geo. M. Wisner, Chief Engineer, and C. R. Dart, Bridge Engineer. The work is subject to the approval of the city's Department of Public Works; John Ericson, City Engineer, and Thos. G. Pihlfeldt, Engineer of Bridges and Harbor. The contractor for the substructure is the Great Lakes Dredge & Dock Co., of Chicago.

Birmingham Water-Rate Agreement

An agreement has been reached between the Birmingham Water Works Co. and the governing Board of Commissioners of the city of Birmingham, Ala., which is intended to dispose of the rate controversy in that city. While the agreement has been accepted by the water company and the city commissioners, yet there is still a question as to whether the offer and acceptance must be subject to a referendum election. If it is finally legally adopted all present litigation will be ended, except over a pending license tax.

The terms of this formal agreement apply on and after Apr. 1, 1915, and until Jan. 1, 1921, on which date the old rights and duties of both parties are reacquired, except that a right to purchase by appraisement continues in effect.

The water company is working under contracts made with the city and ten former suburban municipalities. This agreement modifies all the existing contracts to a uniform basis. The main provisions of the new plan are abstracted below.

FLAT RATES

For a three-room dwelling, $1.50 per quarter plus 25c. per additional room up to 10 rooms, and 12½c. each above that number. Reception hall, butler's pantry, basement and attic rooms not counted as rooms under these rates unless used for living or sleeping. For a water-closet in a private three-room dwelling, $1 per quarter or $1.25 in a dwelling of more than three rooms; each additional water-closet, 62½c. per quarter. Private-family bathtubs, $1 per quarter.

For a store, shop, office or restaurant, $1.50 to $2 per quarter, according to size; water-closet in these, $1.25 each per quarter.

Faucets, etc., for sprinkling hose, 5c. per annum per front foot of property, with a minimum annual charge of $2.50.

METER RATES

For a daily average of 4000 gal. or less, 20c. per 1000 gal.; 17½c. per 1000 gal. for a daily average of 4000 to 5000 gal. Rates for larger quantities as specified in the old contracts.

Meters are to be read and bills rendered approximately quarterly, except that for large consumers the readings and billing is to be monthly.

INSTALLING METERS

Any consumer may require a company to place a meter on his service pipe at its expense, and the water company may place a meter on any customer's service at its expense, in both cases making charges according to the meter readings.

MINIMUM CHARGES ON METERED SERVICE

Minimum quarterly charge, $2.25 for each dwelling, except that the charge is not to exceed three-fourths of the flat-rate charge for the same service. The consumer can draw without further change as many thousand gallons of water per quarter as 20c. is contained times in the minimum charge.

Where a meter is on a service pipe supplying more than one dwelling, the owner of which pays the bill for the entire premises, as in apartment houses, the minimum quarterly charge is to be $2.25 for eight rooms or less, and proportionately larger for over eight. The minimum charge is not to exceed three-fourths of the flat rate for such service.

Minimum charge for a single store, shop, office or restaurant, $2.25 (except that it is not to exceed three-fourths of the flat rate). Where the water bill for two or more establishments is paid by a single owner the minimum charge is to be $2.25 for three or less and proportionately larger for more than three.

The minimum quarterly charge on metered services is not to be affected by sprinkling use.

VACANT PREMISES

Reductions in both flat rates and minimum charges are made where water is supplied from one service to more than one dwelling if a dwelling is vacant, provided the vacancy is continuous throughout a calendar month and notice is given the company (a fee of 15c. per notice allowed to cover additional bookkeeping and inspection).

Where only one dwelling is served, no reduction will be made for vacancy as long as pressure is kept on, but the reduction may be secured (though not for less than a calendar month) without cost by serving written notice on the water company to turn off the supply.

METER RENTS

No meter rent charged for ⅝-in. or smaller meter, nor for a meter placed on a service supplying water to more than one dwelling or more than one place of business, nor for a meter on municipal service.

Meters larger than ⅝-in. on service pipes supplying a single commercial establishment to have, in place of the minimum charge, a rent varying from 25c. per month for a ¾-in. meter to $2.50 per month for a 4-in. meter.

WATER USED BY CITY

All water used by the city, other than for fire protection, hydrant testing, etc., and other than for resale to consumers, will be metered and treated as passing through a single meter under the rates applicable to other large consumers. Services supplying water for municipal purposes will not be subject to minimum charge.

In consideration for treating water for resale in North Birmingham as water for municipal purposes, the license tax assessed each year is not to exceed 2% of the gross city receipts of the company for the previous calendar year.

PUBLIC FIRE HYDRANTS

For public fire hydrants $35 per annum, payable in equal monthly installments. The city has the right to require the water company to lay 750 ft. of new water main (not smaller than 6-in.) for each new hydrant installed. If the extension required for one hydrant is less, a credit of the balance up to 750 ft. may be applied to longer extensions. The water company is not obliged to make extensions for additional hydrants while the city is more than one month in arrears for hydrant rental, and all deferred payments bear interest at 6%.

PRIVATE FIRE PROTECTION

Automatic sprinkler heads, 5c. each per annum; opening for 2½-in. fire hose, $4 per annum; opening for 1½- or 2-in. fire hose, $3 per annum; opening for 1 or 1¼-in. fire hose, $2.50 per annum; private hydrants, $35 each per annum for the first three, and $25 per annum for those in excess. No charge less than $35 for water service for private fire protection.

No liability is attached to the water company for damage or injury resulting from inadequacy or failure of service in event of fire.

MUNICIPAL OWNERSHIP

The city acquires the right, if it desires, to purchase the water-works in their entirety, but not in part, at a value to be fixed by a board of five appraisers in case the parties cannot themselves agree. The city agrees not to undertake to acquire any or all of the property in any other way. If the city attempts condemnation, this agreement terminates and the company can restore the previous contracts with the city of Birmingham and the various suburban municipalities since absorbed; or the company may allow the property to be acquired by condemnation and collect from the city, in addition to the award and to the compensation provided for in the agreement, a sum equal to the difference between such compensation after April 1, 1915, and the charge that would have existed for municipal water service prior to the agreement.

On receipt of four months notice the water company will furnish the city an accurate inventory and appoint an agent to arrange the transfer. In case of non-agreement, the board of appraisers is to be chosen, two by the city, two by the water company and a fifth by the other four. They are to be disinterested, non-partisan, non-resident persons.

The appraisers most consider "all lawful and proper elements of value including commercial value of the business

as a going concern and the influence of depreciation and appreciation." No allowance is to be made for franchises or contracts.

In the event of purchase, transfer of the property is to be made as of the last day of some quarterly payment period of water bills. There are to be excepted from transfer all cash on hand, bills and accounts receivable of the water company. Bills of the company against the city will be paid at the time of transfer. All unpaid bills of other consumers are to be collected for the water company if possible.

If the people by referendum following the award of appraisers elect not to take and pay for the property at appraised value, or if the city is unable to raise the funds, then the city shall have the right to revive the matter five years from that date and at each recurring period of five years.

Pulling Falsework Piles

The centering for the arches of the new reinforced-concrete bridge at Saskatoon, Sask., Canada, was carried on timber piles, which were driven to refusal with a steam pile-hammer. The bed of the river was composed of a layer of boulders embedded in a course of sand overlying blue clay, and the penetration was 8 to 12 ft. The load was approximately 22 tons per pile, without any settlement taking place. During the winter, and while the river was covered with ice averaging 18 in. thick, the question of removing these piles arose, owing to the fact that the Government requires all obstructions to be removed from the bed of the stream. It was decided that the piles could be pulled as cheaply as they could be sawn off at the bed of the stream, and the method described below was adopted. This is shown in the accompanying view, which shows also the arch ribs of one of the spans.

A four-leg derrick was built, with 10x10-in. timbers for sills and legs 8x8 in. A short 10x10-in. cap on top of the legs carried a heavy steel chain in which was hung a set of steel double blocks threaded with steel cable of 12-ton capacity. This was hitched to one side of the pile with a ¾-in. steel chain, while a 20-ton jack was used on the opposite side under a lifting block chained to the side of the pile. A 10x10-in. timber was used as a base for the jack. At the end of the steel cable, which ran through a snatchblock, a ring was fastened into which was hitched a set of double blocks threaded with 1¼-in. manila rope. The free end of this passed around a capstan, operated by a team of horses.

All this equipment was supported on the ice. The jack was used to assist in starting the pile and the tackle handled it afterward. In moving the derrick all that was necessary was to hitch the team to the corner of the derrick and pull it over the next pile. From 10 to 17 piles have been pulled by this method in one day. The crew required is as follows: 1 foreman, 3 laborers handling jack and tackle, 2 laborers cutting ice from around the piles and setting hitching blocks for work ahead, and one team.

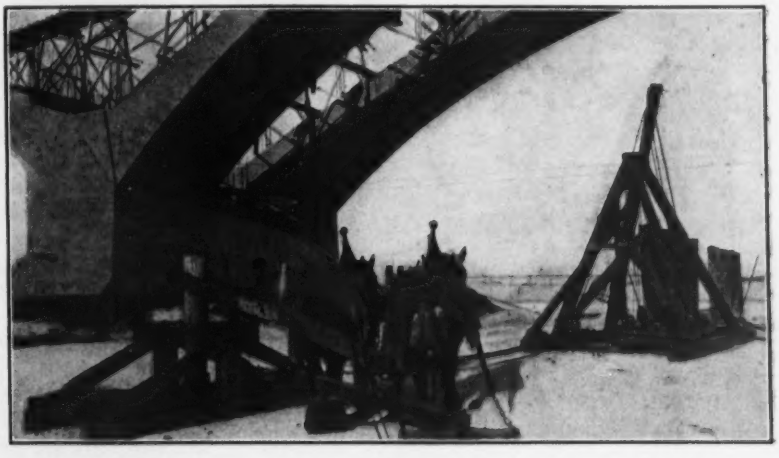
This work was done by the firm of R. J. Lecky & Co., of Regina and Saskatoon, who were the contractors for the bridge. For information we are indebted to L. O. Beam, Superintendent of Construction for this company.

Ventilation of Stampede Tunnel, Northern Pacific Ry.

The air in the Stampede Tunnel of the Northern Pacific Ry., in the Cascade Mountains, under certain atmospheric conditions and heavy traffic has been so bad that a forced-ventilation plant has been installed at a total cost of about $150,000.

This tunnel is nearly 2 mi. long and has a summit about a third of the distance in from the west end. For most of the time, due to prevailing winds, there is a natural draft through the tunnel. But at times, due in part to the location of both portals in ravines, there is no draft, and then when trains have to pass in close succession there is no little discomfort and some danger to employees.

The ventilating plant was built and installed by the B. F. Sturtevant Co., of Boston, using the patents secured by C. S. Churchill and C. E. Wentworth of the Norfolk & Western Ry. for a design employed in the Elkhorn tunnel in 1901 (see ENGINEERING NEWS, May 23, 1901, p. 1369). The Stampede Tunnel installation is designed to clear the tunnel of smoke in 5 min. after the passage of a train. The equipment is located at Stampede station near the west portal and forces air in the direction of the generally prevailing winds.



PULLING THE FALSEWORK PILES OF THE NEW SASKATCHEWAN RIVER BRIDGE AT SASKATOON, CANADA

There are two multi-vane fans, 61½ in. wide and 116½ in. in diameter, each driven at 220 r.p.m. by a 16x16-in. horizontal steam engine and furnishing 270,000 cu.ft. of air per minute. Steam comes from five 150-hp. boilers equipped with automatic stokers (for low-grade fuel) and forced draft. Coal is handled from cars to stokers without hand labor. The air is delivered to the tunnel from a nozzle built around the edges of the portal. The outer part of the nozzle is of concrete and the inner shell is of wood on a steel frame.

The Gasoline Motor Omnibus, the use of which is so rapidly increasing, has put an end to the exploitation in the United States of the so-called "railless electric traction system," in which a vehicle running on an ordinary road is driven by current from an overhead trolley wire. In England, however, this system is still being pushed. The London "Times" recently announced the opening of a five-mile line in Wales. Four electric wires are strung over the roadway and each omnibus carries two trolley poles, making connection with the outgoing and the return circuits.

Illinois Section of the American Water-Works Association

The Illinois Water Supply Association was organized in 1909 with a membership of 38, and in 1914, when its membership had increased to 268, it decided to affiliate with the American Water-Works Association. Its first meeting as the Illinois Section of the larger association was held at the University of Illinois (Champaign, Ill.), Mar. 9 to 11, 1915. The meeting was well attended, and there were several exhibits of water-works materials and appliances. The third day was devoted to a trip to Danville, visiting the water-works plant and some coal mines. W. J. Spaulding, City Commissioner, Springfield, Ill., was elected Chairman of the section.

WATER TREATMENT—W. R. Gelston (Quincy, Ill.), described the new filter plant at Quincy, built in 1914. A paper by C. A. Jennings (Chicago) referred to the adoption of liquid chlorine at the Bubbly Creek plant at the Chicago stockyards. The salvage of wash water at the Champaign-Urbana filter plant was described by H. E. Babbitt (University of Illinois), and a paper by Langdon Pearse (Chicago) dealt with the loss of head on strainers of water filters. The control of hypochlorite treatment at Denver was described in a paper by W. W. DeBerard (Chicago). The presence of arsenic in filter alum was dealt with by Edward Bartow (University of Illinois) and L. A. Fritze (Moline) discussed the use of river sand as a satisfactory medium for filters. A paper on "The Water Supply of Longview, Tex.," was presented by Paul E. Green (Chicago). W. A. Pownall (Wabash R.R.) dealt with the treatment (particularly the softening) of water for locomotive boilers. "Soft Water" was the subject of a paper by C. L. Kennicott (Chicago), and "Cooled Drinking Water" was discussed by R. F. Massa (Fort Wayne).

ADMINISTRATION AND REGULATION—The work of the Illinois and Wisconsin public-utilities commissions in the regulation of water-works was outlined in papers by C. G. Bennett and C. M. Larson, respectively, while the general subject of the application of the theories of government regulation to the management of public utilities was discussed at length by D. A. Graham (Chicago). Prof. R. E. Heilman (University of Illinois) briefly discussed the economic aspects of water-works operation. A paper on "Modern Accounting for Public Utilities" was read by E. A. Pratt (Peoria, Ill.).

WATER-SUPPLY AND WATER-WORKS—Frank De Wolf (Illinois Geological Survey) discussed the artesian water-supplies of the Chicago district, C. B. Williams (Chicago) presented a paper on the possibilities of improved water-supply from deep wells in Northern Illinois, and R. R. Perkins read a paper on "Artesian Well Water at Elgin, Ill."

O. T. Smith (Freeport, Ill.) described the system adopted in rebuilding and reinforcing an old water-works plant under conditions of an expiring franchise and inability of the city to purchase the plant. A commission of three engineers was formed (two appointed by the city and the company and the third selected by these two) to make a valuation. After their report had been approved by both parties the commission reported on the work necessary and the means of providing for it.

In a paper on "Water-Waste Prevention by Individual Meters and District Meters," R. O. Wynne-Roberts, Regina, Canada, stated that Regina has three permanent recording district meters.

Other papers presented were: "The Ontario Statutes Affecting Water-Supply and Sewerage," by F. A. Dallyn (Toronto); "The Relation of Bacteriological Standards and Vital Statistics at Hannibal, Mo.," by W. F. Monfort (St. Louis); "The Value of Publicity to the Water-Works Man," by S. C. Hadden (Chicago).

Discussion of Reinforced-Concrete Standpipes

Experience with reinforced-concrete standpipes was the subject of an interesting discussion at the Mar. 10 meeting of the New England Water Works Association. From all the testimony presented the conclusions were rather unfavorable to the use of concrete for standpipes over 50 ft. high, in latitudes subject to freezing weather.

The discussion was opened by Thomas McKenzie, Engineer of the Westerly (R. I.) water-works, who summarized progress in the erection of concrete tanks since the first one was built at Little Falls, N. J., in 1899. Since then some 30-odd concrete standpipes have been built in this country, many of them in New England. The one at Attleboro, Mass.,* was erected in 1904; two were built in 1906, three in 1909, four in 1910, eleven in 1911, four in 1912, seven in 1911 and three in 1914.

WESTERLY, R. I.—Mr. McKenzie prefaced his remarks on the Westerly standpipe (40 ft. diam., 70 ft. high) by saying he did not wish to appear as arguing either for or against concrete. Having the experience gained in the construction of the Attleboro standpipe, the same contractor, the Aberthaw Construction Co. of Boston, used every means of making the concrete watertight. The materials and workmanship were the best. Leaks at the construction joints immediately developed. Hot paraffin was tried for waterproofing but proved unsuccessful. More leaks developed and the cracks were filled with a plastic slate. This was not successful and gave a bad taste to the water. More leaks developed every time the tank was emptied and refilled. Finally, in 1911, the whole inside was waterproofed by the process of F. W. Bird & Son (East Walpole, Mass.), by means of alternate layers of felt saturated with a bituminous compound and coats of a bituminous paint. Five layers of felt were applied and the work cost $1782.

Mr. McKenzie said he did not know of a concrete standpipe which did not show seepage and that this seepage could not be prevented until an impervious concrete was developed. Since the application of the asphaltic waterproofing the Westerly standpipe had developed no conspicuous leaks. He did not know what effect ice would have on the waterproofing, for the Westerly standpipe never had ice troubles because it was filled with ground water of a practically uniform temperature of 54° F., summer and winter.

ATTLEBORO, MASS.—The concrete standpipe at Attleboro (50 ft. diam., 100 ft. depth) was leaky and unsatisfactory from the time it was built, according to Herbert F. Conant, until recently Superintendent of the water-works. It was first attempted to waterproof the inside by the Sylvester process (a solution of castile soap and alum). Some 13 coats of this wash were applied in all,

*"Engineering News," Feb. 21, 1907, Aug. 19, 1909, Aug. 26, 1909.

but due to the hardening and cracking of the surface thus formed, the results were unsatisfactory.

Last year the inside of the standpipe was waterproofed by the same process used on the Westerly standpipe. The work was also done by F. W. Bird & Son, at a contract price of $3000. In addition to want of waterproofness, the concrete spalled off the outside of the standpipe, to such an extent as to expose the reinforcing rods at some places. Various attempts were made to plaster concrete over these, but the structure was so unsightly and aroused so much popular suspicion that the entire standpipe is being encased in an 8-in. brick wall.

WALTHAM, MASS.—Much the same experience was had at Waltham (100 ft. diam., 37 ft. deep) as at Attleboro. The concrete has spalled off the lower part of the standpipe, making an unsightly structure; but it is not considered that its soundness and reliability are at all impaired. An unsuccessful attempt to waterproof the interior was made two years ago by applying a brush coat of tar.

MANCHESTER, MASS.—This standpipe (50 ft. diam. 72 ft. high) developed a large crack as soon as it was filled. There was seepage at many points. It was attempted to repair the cracks by covering with lead plates, but in the end an asphalt waterproofing was the only satisfactory solution. The outside of the tank has also suffered spalling off and disintegration from frost action.

LEXINGTON, MASS.—An unsuccessful attempt was made at the Lexington standpipe to waterproof the interior by plastering on a coating of canvas, but it was stated that this canvas soon accumulated in the bottom.

GENERAL—Hiram B. Andrews, Engineer of Simpson Bros. Corporation, who has designed a large number of tanks in New England,* stated that in some of the concrete standpipes erected they had had no difficulty from seepage. They had increased the richness of the concrete and in the most recent structures the mix was 1:1:2. These standpipes, he said, had shown no leakage but that none was over 60 ft. high. Mr. Andrews considered richness of concrete the best waterproofing.

CONCLUSIONS—In every instance mentioned, the south or sunny side of the standpipe showed the most cracks and leaks. Several structures showed an increase in cracks every time the standpipe was emptied and filled again. Seepage in some cases was said to be affected by atmospheric conditions. Whether the moisture came from the atmosphere or from the inside of the tank, it was considered the chief cause of the spalling off and disintegration of the outside concrete and the failure in most cases was through the agency of frost. Concrete standpipes under 50 ft. high seemed capable of being made watertight.

The general opinion seemed to be that waterproofing in the form of an elastic film on the interior was an essential feature of construction. Experience has not yet shown the lasting qualities of such a film, or the effect of ice on it. It was also suggested that the exterior of the standpipe must be protected in some way against the elements and weathering. The opinion was expressed that on account of the frost action, results in warmer climates were and should be perfectly satisfactory.

*See "Engineering News," July 27, 1911, for an abstract of Mr. Andrews' paper, "A New Theory for the Design of Reinforced Reservoirs," before the Boston Society of Civil Engineers. This article also contains a list of concrete standpipes and bibliography up to that time.

Liquid Chlorine at the Bubbly Creek Water-Filtration Plant*

BY C. A. JENNINGS†

The Bubbly Creek filter plant at the Chicago Stock Yards set the lead in the use of hypochlorite of lime in this country for water disinfection. This was during the summer of 1908. Subsequently experiments were begun at this plant with an electrolytic cell for the production of chlorine from salt brine. These experiments were carried out very extensively and thoroughly. The writer finally concluded that in comparison with hypochlorite and liquid chlorine, the production of chlorine for water disinfection by means of an electrolytic cell was expensive, uncertain and demanded considerable attention.

Very recently a liquid-chlorine apparatus was purchased. Chlorine is received in cylinders that hold 105 lb. of the liquefied gas. From the experience gained by operating this apparatus during the past month the writer has concluded that in comparison with the use of hypochlorite at the Bubbly Creek filter plant—

1. There is considerably less labor involved.
2. The absorption of the gas by the water is more rapid.
3. There is no loss of chlorine, and smaller quantities can be used to accomplish equivalent results.
4. There is no deterioration of the chlorine in the cylinders while using or while stored.
5. The changing of the rate of application is easily, quickly and accurately accomplished.
6. There is no odor of chlorine about the plant.
7. The cost is considerably less.

There are features of the Bubbly Creek filter plant which, the writer believes, are peculiar to it. These features are the enormous amount of hypochlorite necessary to disinfect the water, the poor mechanical means for getting into solution all of the hypochlorite used, which resulted in a large loss of available chlorine, and the irregularity in the operation of the plant due to a varying consumption and small filtered-water storage capacity. It has often been necessary to run one or two filters for a time and then suddenly have to use eight filters.

The ratio of costs during one month's operation with liquid chlorine, with an average raw-water supply and the treated filtered water as low in bacteria as when using hypochlorite, was 1 to 3 in favor of liquid chlorine. It is hardly probable that every plant will show such a large difference in the costs of disinfection by the two methods.

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A Small Sewage Testing Station has been established at Decatur, Ill., for the purpose of determining the best method of treatment for sewage containing a considerable amount of waste from a large starch factory. This station includes a small motor-driven pump, a grit chamber, settling tank, sprinkling filter and a secondary basin. The cost was about $1500. This was referred to in a report at the recent annual meeting of the Illinois Society of Engineers and Surveyors, at Springfield, Ill., as being of interest in illustrating the possibility of small towns studying at comparatively slight expense the conditions to be observed in designing a plant to meet special local requirements. In this case the character of the sewage is very unusual and little is known of methods of treatment suitable for it.

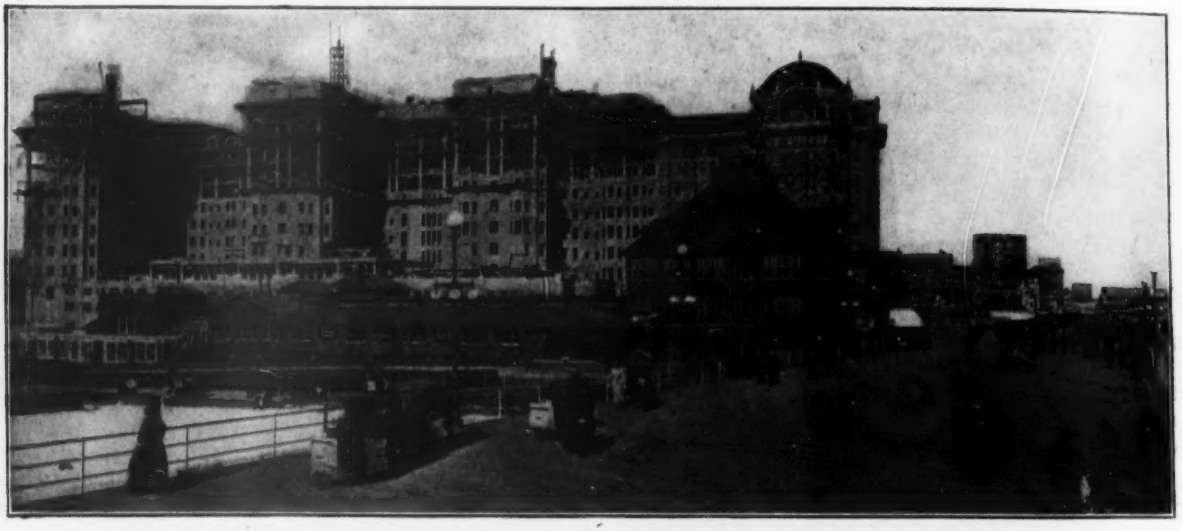
*Abstract of paper read before the Illinois Section of the American Water Works Association, at the University of Illinois, March 9, 1915.

†Consulting Engineer, Chicago, Ill.

News of the Engineering World

The Highest Reinforced-Concrete Building

The skyline of Atlantic City, N. J., has long been distinguished by two towers, that on the Traymore Hotel and that on the Marlborough-Blenheim, which far exceeded in height any of the other buildings on the beach. The accompanying view, taken on Mar. 13, 1915, shows the reconstructed Traymore Hotel, with the new portion overtopping the hitherto predominant boardwalk tower.



THE NEW TRAYMORE HOTEL, ATLANTIC CITY, UNDER CONSTRUCTION
(View taken Mar. 13, 1915, showing reinforced-concrete frame for new 17-story section and old boardwalk tower)

This reconstructed building will be one of the largest reinforced-concrete structures in existence and will be the highest reinforced-concrete building yet attempted. The old frame part of the hotel to the rear of the reinforced-concrete boardwalk tower, which was built some years ago, was torn down commencing July 1, 1914. The new structure will be turned over to guests June 1, 1915.

The new Traymore Hotel covers an area 520 ft. deep and 140 ft. wide on the wings showing in the view. It will vary in height from the eight stories of the old tower to a central section 17 stories high. At the time the accompanying view was taken 14 of these stories had been erected. It will contain 634 guest rooms. The structure has reinforced-concrete beams and girders carrying tile-and-concrete floors and resting on reinforced-concrete columns, which in locations of heavy loading or where space-saving was an important consideration are of structural steel fireproofed with concrete. The exterior is of brick matching in tone the present terra-cotta face of the boardwalk wing.

The architects for the building are Price & McLanahan; the engineers, Gentner & Shaw, and the contractors, Cramp & Co., all of Philadelphia, Penn.

Largest Battleship Launched; the U. S. S. Pennsylvania

The oil-burning superdreadnought "Pennsylvania," which when equipped will be the most powerful battleship in the world, was launched successfully on Mar. 16 at Newport News, Va. The following are some of her important dimensions: Overall length, 608 ft.; extreme breadth, 97 ft. 1½ in.; draft on trial, 48 ft. 10 in.; trial displacement, 31,400 tons; full load displacement, 32,567 tons; fuel-oil capacity, 694,830 gal. (2322 tons); indicated hp., 31,500; speed on trial, 21 knots; cost when completed, $13,000,000.

The armament consists of a main battery of twelve 14-in. turret rifles so arranged that all can be fired on either broadside. Six guns can be fired dead ahead and six dead astern. The second battery will consist of twenty-two 0.51-caliber 5-in. rapid-fire guns; four three-pounder saluting guns; two one-pounder guns for launches; two 3-in. field pieces, and two 0.30-caliber machine guns. There will also be four 21-in. submerged torpedo tubes as part of the main battery.

The U. S. S. "Pennsylvania" is the largest dreadnought in the world, and the following table compares her size, speed, armament and complement with the largest warships in the British, German and Japanese navies:

	"Pennsylvania"	"Queen Elizabeth" (British)	"Ersatz Worth" (German)	"Fuso" (Japanese)
Displacement	31,400 tons	27,500 tons	28,000 tons	30,600 tons
Speed	21 knots	25 knots	23 knots	22 knots
Main battery	12 14-in.	8 15-in.	8 15-in.	12 14-in.
Second battery	22 5-in.	16 6-in.	16 6-in.	16 6-in.
Complement	855 men	900 men	1000 men	1100 men

The effective range of the 14-in. guns is 22,500 yd., or nearly 13 mi. The charge of powder for the 1400-lb.

shell weighs 360 lb. The main belt of armor is 14 in. thick and 18 ft. in depth, extending well below the water line. The barbettes are 14 in. thick, while the sloping plates of the turrets are 18 in. in thickness. This armor protection is heavier than that of the "Queen Elizabeth."

Engineers for the New York Constitution

A meeting of the American Society of Civil Engineers was held in New York on Mar. 17 to discuss the relation of the engineering profession to the proposed new constitution for the state to be written in the Constitutional Convention starting in April, 1915. A committee composed of Arthur S. Tuttle, Henry W. Hodge and Alfred D. Flinn prepared a report containing suggestions governing the conduct of the engineering functions of the state and the appointment of officers who are or should be of the engineering profession. A full account of the meeting will appear in next week's issue.

Enlarging the Port of New Orleans

A state constitutional amendment adopted in Louisiana in November, 1914, provides for a lock canal at New Orleans, to connect the Mississippi River with Lake Pontchartrain, and it is expected that work on this project will be commenced in 1915. The canal is to be publicly owned and operated, but the land along the banks is to be open to private ownership and development, the purpose being to develop a manufacturing and industrial district with water and rail connections. There will be slips or lateral branches at various plants. The municipal railway which now extends along the river front, and connects all the railway lines with the docks and wharves, is to be extended as a belt line around the city, so as to serve the outlying industrial districts.

The canal is to be within the city limits, but no definite location has been made. The difference in water level between the Mississippi River and Lake Pontchartrain varies in accordance with the flood conditions of the Mississippi River and the variation in the height of water in the lake. There is practically no tide in Lake Pontchartrain and the variation in the water level of the Mississippi River between extreme high water and extreme low water varies in different years. An approximate amount is 20 ft. between these river levels. Assuming the ordinary stage of the Mississippi River as 10 ft. above low water, and Lake Pontchartrain at its usual elevation, the river would be about 9 ft. above the level of the lake. A contract for the engineering work on the project has been awarded to Ford, Bacon & Davis, of New York, by the Board of Port Commissioners of New Orleans.

Benzol Plant Erected in 29 Days

A plant for producing benzol from coal gas produced in the manufacture of coke has been established by Thomas A. Edison, at Johnstown, Penn. The coke ovens of the Cambria Steel Co. are used. The absorbing and refining plant was erected in 29 days. The method is the familiar one in use in Germany and elsewhere.

Benzol is the base of carbolic acid and of aniline dyes and, until the outbreak of the war, was furnished very largely by Germany. The purpose of the new plant, whose capacity is 2000 gal. per day, is to supply the Edison factories with carbolic acid. A second plant, of 3000 gal. capacity, has been erected for this same purpose at Sydney, N. S. The Edison factories use a ton of the acid per day, and excess production will be sold to other manufacturers.

The American Nitrogen Industry

At a joint meeting of the American Institute of Electrical Engineers and the American Electrochemical Society in New York City, Mar. 12, a paper was presented on "The Cyanamid Process," by Frank S. Washburn, President of the American Cyanamid Co. (which is the only company in America producing artificial nitrogen compounds, and whose plant and processes were described in ENGINEERING NEWS, Jan. 7, 1915).

Mr. Washburn's paper was a discussion of the possibilities of an American nitrogen industry and did not enter into details of the manufacture of cyanamid. A few of the important points of his paper are very briefly summarized below.

Two-thirds of the product from the world's nitrogen fixing plants is cyanamid. About 80% of the artificial nitrogen used in North America is applied to agriculture. The value of the products so used amounts to about $75,000,000, compared with $7,000,000 in the other two important uses (nitric acid and ammonia for the industries). A review of American statistics shows that crops have increased while the exports of food stuffs have decreased and prices have risen. The time has been reached where it is necessary to increase the crop yields toward the figures obtainable in Europe and this necessitates the larger use of artificial fertilizer. The unit expenditure for fertilizer is ten times as great in Germany as in America, and the unit increase in value of products is much greater still. Cyanamid is the only artificial nitrogenous product which can be used directly in agricultural service and it is well adapted to the cheap production of an ammonium phosphate which is of even more service in agriculture. Agricultural uses will predominate over industrial, especially as these can be well served by the nitric-acid and ammonia processes. Phosphate rock is mined only in Florida and Tennessee, and the cost of transportation to the nitrogen works will be the governing factor in the location of the latter. The plant must be on a waterway near a cheaply developed water power. Much of the product will be distributed by the empty returning boats and the cost of such transportation of the finished product will largely be only the expense of handling. This type of development will result in the concentration of large nitrogen-fixation works much like the grouping of German chemical industries and the American meat-packing plants. Out of an estimated total of $35,000,000 for an initial development, some $8,000,000 represents electrical machinery.

Two Gasoline Tanks Exploded at the plant of the Crew-Levick Oil & Gasoline Co., Brooklyn, N. Y., on Mar. 13. Four boys were killed by falling walls and many persons were cut by flying glass from broken windows in the vicinity.

Another Fire in the Edison Plant at West Orange, N. J., on Mar. 8, caused some excitement but little damage to building or contents. The building affected was No. 22, a two-story frame with corrugated-iron covering, which was used for master-record manufacture. This building stood almost in direct line of the fire of Dec. 9, 1914, but strangely enough was only slightly scorched at that time.

Timber Floors Collapsed in a five-story leather storehouse at 61 South St., Boston, late in the night of March 8, the three top floors giving way and precipitating their contents upon the second floor, which sustained them. The building has brick walls and wooden floors which were not sufficiently strong to carry the heavy loads imposed upon them. The enormous pile of leather now resting on the second floor has forced the front wall slightly out of plumb, but it is still intact. The building was about 30 years old and was erected under building laws which allowed the joist to rest on the frame without any fastening.

A Second Cable Burnout on the New York City subway (Interborough Rapid Transit Co. system) occurred near Broadway and 42d St. at 3 a.m., Mar. 15. The effects of the accident were like those of the one on Jan. 6 at Broadway and 53d St. (see "Engineering News," Jan. 14, 1915). The subway for some distance above and below was filled with the smoke from burning insulation, and it even entered nearby hotels. Fortunately few trains were running and none were caught in the affected zone. Traffic was resumed at 5 a.m. The Public Service Commission is investigating reports that a workman, drilling on the new subway excavation, cut through the high-tension feeder ducts and caused a short-circuit which started the trouble.

Prizes for Essays on Fire Prevention are offered to high-school students by the National Municipal League. There will be a first prize of $30 and a second prize of $20. The essays must not exceed 2500 words in length and must be in the hands of Clinton Rogers Woodruff, secretary National Municipal League, North American Building, Philadelphia, by Apr. 15, 1915. Further particulars may be obtained from Mr. Woodruff.

Base Rate for Electricity in the Borough of Manhattan and part of the Bronx, New York City, has been ordered reduced by the Public Service Commission for the First District of the State of New York from 10c. per kw-hr. to 8c., with a general revision of the whole schedule to accord. The company is allowed to charge extra for lamp renewals, etc. This order is the result of the cases of Stadtlander and Ewoldt against the New York Edison Co. In 1911 the Edison Co. established a new and lower schedule of rates, but the only substantial reductions were for those consumers paying more than $25 per month. The complainants alleged discrimination against small consumers. The present earnings of the New York Edison Co. were $7,803,000 in 1913 and $7,150,000 in 1914. Under the proposed reduction to an 8c. base rate the earnings would drop to about $5,800,000, which is a return on nearly $100,000,000 investment. The company claims a value of some $132,000,000. It is reported that in the commission a motion was made by M. R. Maltbie for a base rate of 6½c. per kw.-hr. for lighting, with 6c. for power and a meter charge of 50c. to $1 per month. Mr. Maltbie held that the maximum amount on which the company was entitled to a return was $60,000,000. The larger base rate prevailed in the commission, evidently on the grounds that $100,000 would surely cover the capital actually expended in the enterprise.

PERSONALS

Mr. Charles R. Hudson, of Mexico City, Mex., has resigned as Vice-President of the National Rys. of Mexico.

Mr. Alberto J. Pani, Vice-President of the National Rys. of Mexico, at Mexico City, Mex., has been authorized by the company's Executive Committee, to assume the duties of President in the absence of Mr. Luis Cabrera.

Mr. Howard Elliott, Chairman of the Board of Directors and President of the New York, New Haven & Hartford R.R., of Boston, has been elected a life member of the Corporation of the Massachusetts Institute of Technology.

Maj.-Gen. George W. Goethals, M. Am. Soc. C. E., Governor of the Panama Canal Zone, in a speech which he delivered at the recent banquet of the Society of the Chagres, announced his probable retirement as Governor within a year.

Commander H. H. Rousseau, U. S. N., M. Am. Soc. C. E., has been promoted by Congress to the rank of Rear-Admiral. This is a correction to the statement made in a news note on p. 459 of our issue of Mar. 4 that he had been made Captain.

Mr. L. F. Lonnbladh, Engineer of Maintenance-of-Way of the Missouri, Kansas & Texas Ry. Co., has been made Chief Engineer with headquarters at Dallas, Tex. Mr. A. A. Matthews succeeds Mr. Lonnbladh, with headquarters at Dallas.

Mr. Julian E. Woodwell, M. Am. Inst. E. E., who will dissolve partnership with Mr. Louis B. Marks, M. Am. Inst. E. E., about May 1, as announced in our issue of Mar. 4, will continue the practice of electrical and illuminating engineering as well as mechanical engineering. His offices will be at 8 W. 40th St., New York City.

Messrs. Joseph W. Ellms, M. Am. Soc. C. E., and Seabury G. Pollard, M. Am. Soc. M. E., of 2807 Union Central Bldg., Cincinnati, Ohio, have dissolved partnership. Mr. Ellms will continue the practice of consulting engineering at the same address. Mr. Pollard expects to spend several months in the West before taking up any further engineering work.

Messrs. Frank W. Tuttle and J. J. Pike, Shubert Theater Bldg., Kansas City, Mo., have dissolved partnership. Mr. Tuttle and Messrs. Albert T. Ayres and Chas. D. Woodward have organized the Tuttle, Ayres & Woodward Engineering Co., 901 Drear-Leslie Bldg., and Mr. Pike, with Mr. Harry T. Tidd, has organized the Pike-Tidd Engineering Co., 416 Scarritt Bldg., Kansas City. Both firms will engage in civil and municipal engineering.

Mr. William Alfred Worthington, Vice-President and Assistant Director of Maintenance and Operation of the Southern Pacific Co., has been appointed Vice-President and Assistant to Chairman, and will continue to have his headquarters in New York City. Mr. Worthington was born at Vallejo, Calif., in 1872, and received his education in the schools of Sacramento. In 1887 he entered the employ of the Southern Pacific as stenographer and clerk in the superintendent's office in Sacramento. He has remained with the company ever since.

Messrs. Isaac Harby, M. Am. Soc. C. E., formerly with Bing & Bing and E. Brooks & Co., Ludlow L. Melius, Assoc. M. Am. Soc. C. E., of the Spuyten Duyvil Construction Co., and Louis W. Abrons, Junior, Am. Soc. C. E., of the Perth Construction Co., announce that they have organized under the firm name of Harby, Abrons & Melius, Inc., for the purpose of general contracting and building construction. The officers of the new firm are as follows: Isaac Harby, President; Ludlow L. Melius, Vice-President; and Louis W. Abrons, Secretary and Treasurer.

Mr. Ralph R. Tinkham, Assoc. M. Am. Soc. C. E., who for the past three years has been Assistant Superintendent of the Eleventh Lighthouse District, stationed at Detroit, Mich., has been appointed Superintendent of the Sixteenth Lighthouse District, with headquarters at Ketchikan, Alaska. The district includes all of the coastal and navigable waters of Alaska. Mr. Tinkham will succeed Mr. Milo Hoadley, who will be transferred to Portland, Ore. Mr. Tinkham is a graduate of the University of Michigan. He will start for Alaska about Apr. 1.

Mr. Henry R. Towne, M. Am. Soc. M. E., has retired as President of the Yale & Towne Mfg. Co., of New York and Stamford, Conn., after 46 years of service with the company. Mr. Towne has been elected to a newly created position of Chairman of the company's board of directors. Mr. Walter C. Allen, Jun. Am. Soc. M. E., who has been Vice-President and General Manager for some years past, has been elected to the presidency of the company, and will also continue his duties as General Manager. Mr. Allen entered the company's service 23 years ago.

Mr. Otto H. Tittmann, M. Am. Soc. C. E., Superintendent of the United States Coast & Geodetic Survey, has retired after 48 years of government service. He is succeeded by Dr. E. Lester Jones, Deputy Commissioner of Fisheries. Mr. Tittmann was born at Belleville, Ill., in 1850, and was educated in the public schools of St. Louis. In 1874 he was Assistant Astronomer with the Transit of Venus Expedition to Japan, and was later in charge of several surveying expeditions on the eastern and western coast of the United States. In 1890 he was sent by the Government to Paris to bring to the United States the National standard meter and to inspect the weights and measures offices in London, Paris and Berlin. Mr. Tittmann was appointed to represent the United States in the demarcation of the boundary between Alaska and Canada in 1899, and was made United States Commissioner of the Alaska Boundary in 1904 and of the Northern Boundaries, excepting the Great Lakes, under the Treaty of 1908.

OBITUARY

Ethan Allen Doty, former President of the Edison Electric Illuminating Co. of Brooklyn, N. Y., died at his home in that city, Mar. 10. Mr. Doty was born in New York City 78 years ago.

Morton Riddle, General Manager of the Florida East Coast Ry., died at St. Augustine, Fla., Mar. 4. Mr. Riddle was born at Petersburg, Va., in 1887. He began his railway career as rodman with the Norfolk & Western Ry.

Isaac Rich, M. Am. Soc. C. E., died at his home in Somerville, Mass., Mar. 11, from heart disease. He was born in Brookline, Mass., in 1856, and was a graduate in civil engineering of the Massachusetts Institute of Technology. After graduation Mr. Rich spent a number of years in California in the employ of the Southern Pacific R.R. In 1888 Mr. Rich returned east and was employed on the Boston & Maine R.R. and the New York, New Haven & Hartford R.R. A widow survives him.

Charles A. Schieren, founder and President of the Charles A. Schieren Co., of Brooklyn, N. Y., died from pneumonia at his home in that city Mar. 10. Mr. Schieren was born in Rhenish Prussia in 1842, and attended the public schools in Germany. At the age of 14 he came to America with his parents and worked for several years as a cigar maker. He then entered the belting factory of Philip Pasquay, and upon Mr. Pasquay's death a year or two later assumed full charge of the establishment. In 1868 Mr. Schieren started his own leather-belting factory. He served as Mayor of Brooklyn previous to its being merged with New York City.

L. A. B. Wade, Commissioner of Water Conservation and Irrigation under the New South Wales Government, died Jan. 12, from heart failure. Mr. Wade was 50 years old and had been in the government service since 1880. He became connected with the Irrigation Branch of the Department of Mines in 1890, and in 1892, when the irrigation and water conservation work was placed under the Department of Public Works, he was placed in charge. From that time he was intimately associated with the water-supply and sewerage work of the whole of the state. He designed the Cataract and Barren Jack dams and the diversion works connected with the Murrumbidgee irrigation scheme.

William Arnott Wilson died at the St. Francis Hospital, Pittsburgh, Penn., Mar. 5. Mr. Wilson was born at Plymouth, Penn., in 1867. He began his professional life as a civil and mining engineer with the Lehigh Valley R.R. In 1891 he went to Greensburg, Penn., as Chief Mining Engineer for the independent coal companies in that city, which have since been merged into the corporation known as the Keystone Coal & Coke Co. He organized at various times the Donahoe, Mount Pleasant, Veteran and Mount Pleasant-Connellsville Coke companies and placed a coking plant on a thousand-acre property of the estate of the late William Thaw, of Pittsburgh. Of the latter three companies he had always been Manager and principal owner. Mr. Wilson left a widow.

Sir Charles Augustus Hartley, an engineer of international reputation, died at London, Eng., Feb. 21, in his 91st year. He devoted most of his long career to hydraulic engineering and the design of river and harbor improvements, and at various times was consulted by many of the European governments on port improvements. In 1875 he was one of a committee appointed by the President of the United States to report on the improvement of the Mississippi River, and in 1884 was nominated by the British Government a member of the International Commission for widening the Suez Canal. He was also a member of the congress at Paris to decide on the best route for a ship canal across the Isthmus of Panama. Sir Charles was the author of several books on navigation. He was a member of the Institution of Civil Engineers.

J. C. Rothrey, a prominent railway and electrical engineer in the employ of the Canadian Northern Ry., is dead. After having been missing for a week, Mr. Rothrey's body was found Mar.. 10, partly embedded in the snow near his home in Weston, Ont. Mr. Rothrey was born in Glasgow, Scotland, 67 years ago. He had a wide experience in the construction of electric railways. He was superintendent of the construction of the Gorge Ry., between Niagara Falls and Lewiston, and afterwards became manager of the line, and when the Niagara Falls Park & River Ry. merged with the International Ry. of Buffalo he was made General Manager of the system. He superintended the construction of the International Bridge across the Niagara River at Lewiston, and on its completion was appointed General Manager of an electric railway at East Liverpool, Ohio, where he remained until seven years ago, when he became identified with the Mackenzie & Mann interests in Toronto and was actively engaged in superintending construction work for the Canadian Northern Ry. He leaves a widow and family.

ENGINEERING SOCIETIES

COMING MEETINGS

LAKE MICHIGAN WATER COMMISSION.
Mar. 19. Meeeting at Milwaukee, Wis. Secy., Edward Bartow, Director, Illinois Water Survey, Urbana, Ill.

AMERICAN CHEMICAL SOCIETY.
Mar. 31-Apr. 3. Meeting in New Orleans. Secy., Charles L. Parsons, Box 505, Washington, D. C.

Cleveland Engineering Society—About 600 members, plant owners and plant employees attended a lecture on smoke abatement, delivered by L. P. Breckenbridge on Mar. 9, under the auspices of the Society and the Committee on Smoke Prevention of the Cleveland Chamber of Commerce.

American Institute of Chemical Engineers—The seventh semi-annual meeting will be held in San Francisco, Calif., Aug. 25-28. An itinerary is being arranged in connection with the meeting and will be made public in the near future. The Secretary is J. B. Olsen, Cooper Union, New York City.

American Boiler Manufacturers' Association—The Association has called a meeting for Mar. 29 at 10 a.m., Fort Pitt Hotel, Pittsburgh, of boiler manufacturers and other interested parties for considering the boiler code just completed by the committee of the American Society of Mechanical Engineers.

New England Water Works Association—At the monthly meeting, Mar. 10, it was decided to admit members of the American Water Works Association without the payment of the regular initiation fees. This is in exchange for a courtesy already in effect with the American Association with respect to members of the New England Association. It was announced that the place of the next annual convention had been changed to New York City.

Iowa State Drainage Association—At the annual meeting, held at Webster City, Iowa, Feb. 25, 26, a resolution was passed recommending that the drainage laws be changed to provide a board of commissioners for each drainage district, instead of having drainage work under the county boards of supervisors. Officers were elected as follows: President, H. M. Sparboe, Webster City; Vice-President, J. W. Boyer, Fort Dodge; Secretary, M. F. P. Costello, Ames, Iowa.

Vermont Society of Engineers—The third annual meeting was held in Burlington, at the Hotel Vermont, on Mar. 11. The morning and afternoon sessions were given over to business and the reports and discussions of standing committees. The project of deepening the Narrows at the southerly end of Lake Champlain was discussed at length by the Secretary of the Greater Vermont Association. James Hartness extended a cordial invitation to the Society to hold its next meeting in Springfield, Vt. The officers elected were: President, A. C. Grover, Rutland; Vice-Presidents, E. M. McIntosh, Burlington, A. H. Vorce, St. Albans; Secretary, G. A. Reed, Barre; Treasurer, A. E. Winslow, Northfield; Director for three years, J. W. Votey, Burlington. The membership was increased by 19 during the year, making a total enrollment of 102.

Appliances and Materials

"Safety-First" Design of Crane

A new design of electric traveling crane is being put out by the Northern Engineering Works, embodying all the safety features required by best practice, as a permanent part of the crane proper and not as miscellaneous attachments. Among the particular features are the guarded footwalk, truck-wheel guard, protected gearing, capped bronze bearings, limit switch, graduated control, two brakes for hoist, provisions for quick inspection, etc.

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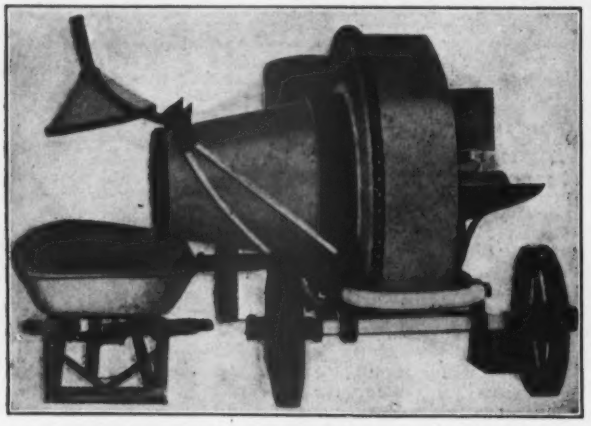
Double-Drum Concrete Mixer

A batch concrete mixer with one drum in which the cement and aggregate are mixed dry and another in which the mixed materials are further mixed with water was exhibited by the Olsen Concrete Mixer Co., Elkhorn, Wis., at the recent cement show in Chicago. The essential elements of the machine are two drums fastened rigidly together and revolving in the same axis. One is cylindrical, and of large diameter, for mixing the dry materials; the other, smaller and of conical

shape, is the wetting drum. The dry materials are first dumped into the large drum, which is then turned the required number of times, when the gate to the adjoining wetting drum is opened and the mixed materials enter the conical drum together with a jet of water. The dump is controlled



DOUBLE-DRUM CONCRETE MIXER

by a cover to the discharge end of the wetting drum. In operation the dry and wet mixing go on simultaneously. The machine has a capacity of 3½ cu.ft. per batch and is mounted on a carriage with a gasoline engine.

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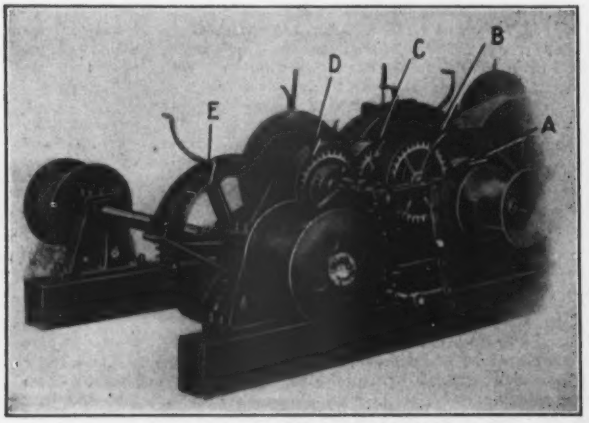
Boom-Swinging Attachment for Hoists

A boom swinger has been designed by T. O. Werner, Chief Engineer of S. Flory Manufacturing Co., Bangor, Penn., which can be attached to any hoist by having the front drum shaft extended so that a pinion can be fastened on it. The arrangement comprises a cast-iron frame and three pairs of gears between the hoist drum shaft and the swinging drum shaft. As shown in the accompanying illustration, the gear on the hoist drum shaft (A) drives two gears on either side of the frame but on one shaft; these in turn drive a gear (D) which is loose on its shaft and, when a friction clutch is thrown, drives the swinging-drum gear (E) to move the boom in one direction. When it is desired to swing in the reverse direction, the first friction gear runs



DERRICK-BOOM SWINGER ON HOIST

idle, driving a second friction gear below, which instead drives the swinging-drum-shaft gear when its clutch is thrown. The frictions are cone type, operated by levers through right- and left-hand nuts, connected through stubs and shafts to a main control lever, which is moved either forward or backward.

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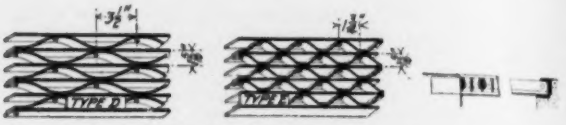
Safety Grating for Subways, Vaults, Etc.

A new type of steel grating has been designed by the Irving Iron Works Co., Long Island City, N. Y., for subway openings, sidewalk vaults, gallery and power-house floors, stair treads, etc. The gratings are formed by joining together, with flat-head rivets at the points of contact, a series of straight and crimped bars. The latter are of less depth and thickness than the former, but the top surfaces of all bars are flush. Various styles are made, two of which are shown. The "style E" is that which has been used for subway openings and the "style D" for general building construction.



IRVING SAFETY GRATING

This grating is designed to replace the old-style grating made from straight bars with bolts and gas-pipe spacers. Any sort of a wheel can roll over it and tools are not easily dropped through it; it is easily walked over as persons' toes and heels do not catch and there is not the slipping seen on straight-bar gratings. The company has contracted to supply over 160,000 sq.ft. of this grating for the New York subways; it is also being used on the Boston subway. It can be designed for any span and any load, but the makers carry stock sizes of "style D" running from 2x3 to 4x12 ft.

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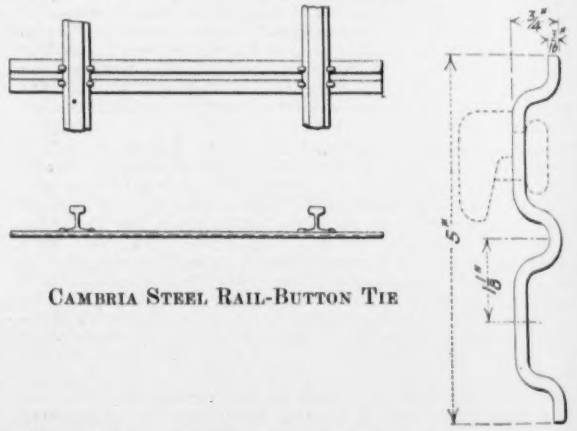
Steel Tie for Mine and Contractor's Railroads

A novel steel cross-tie for mine, factory, plantation and contractor's railroads has been developed by the Cambria Steel Co., Johnstown, Penn. This tie, the heaviest size of which is shown here, is a rolled section designed to secure strength with lightness. The rails are held tight at proper gage by permanently riveted button clips which can be turned with a wrench. This tie is made in three different



CAMBRIA STEEL RAIL-BUTTON TIE

sections and weights for 12- to 60-lb. rails in all gages from 30 to 54 in. Tie sections run in weight from 1.12 to 4 lb. per ft.

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Cheap Construction Searchlight

A special wrecking or construction lamp is being furnished by the Moon Manufacturing Co., 108 N. Jefferson St., Chicago, as a substitute for more expensive searchlights. There is a 250-watt concentrated-filament electric lamp so mounted in an 18-in. reflector that it can be adjusted to spread the light through an angle of 90° or to give a straight beam. For isolated steam shovels, dredges, etc., small turbine-driven generating sets are available.

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Small Concentrated-Filament Tungsten Lamps

The concentrated-filament tungsten lamps in large sizes have proved so popular that the Edison Lamp Works of the General Electric Co., Harrison, N. J., has developed tungsten lamps of similar appearance in the 25-, 40- and 60-watt sizes. This construction gives greater vertical distribution of light than the regular tungsten lamps of corresponding wattages. The new lamps will, therefore, be employed where natural distribution of light downward is required. They can be used in existing sockets and fixtures. These lamps will be made in the same sized bulbs as the corresponding regular lamps, will have the same spherical rating in watts per candlepower and will have a rated average life of 600 hr.